Proceedings and Transactions

OF THE

NOVA SCOTIAN

INSTITUTE OF NATURAL SCIENCE,

FOR

1879, 1880, 1881 1882

VOLUME V

HALIFAX, NOVA SCOTIA:
PROVINCIAL MUSEUM.
WILLIAM GOSSIP, GRANVILLE STREET
1882.

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TRANSACTIONS.

GEOLOGY AND MINERALOGY.

ZOOLOGY.

BOTANY.

METEOROLOGY.

MISCELLANEOUS.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

ERRATA.

1st p. of Cover, and 9th p. of Transactions, for "Professor of Psychology" read Professor of Physiology.

1st p. of Cover and 47 of Transactions, for "Society of Mines" read School of Mines.

Last p. of Cover and p. 3 Proceedings, for "J. M. Jones, M. L. S." read John Matthew Jones, F. L. S.

List of Members,- insert "64, Mar. 7,—W. C. Silver, *Treasurer*, Halifax."

Corresponding Members,—insert "77, May 14, T. C. Weston, Geological Survey of Canada."

Transactions,—p. 29, line 16, for "at the drift" read, in the drift. p. 30, line 36, for "pre-pliocene" read post-pliocene. p. 38, line 9, for "Salmonide" read Salmonidæ. p. 65, line 27, for "steps" read step. p. 68, line 26, comma after "there." p. 72, line 11, for "Forrestere" read Forresteri; and line 32, for "was" read were. p. 81, for "Somers" read Sommers.

For "Minum," p. 12, read Mnium. For "Pyriformi," p. 12, read Pyriforme. For "DeGraas," p. 83, read DeGraff. For "Kercher," p. 83, et seq, read Kircher.

during his long tenure of office.

ORDINARY MEETING, Dalhousie College, Nov. 11, 1878.

WM. GOSSIP, ESQ., *President, in the Chair.*

The SECRETARY announced that the Council had elected as members of the Institute, COLONEL DRAYSON, R. A., LIEUT. COL. COCKBURN, R. A., LIEUT. MURRAY DUNLOP, R. A., LT. COCKERILL, R. A., and JOHN R. MCLEOD, Merchants' Bank, Halifax.

Resolved, That the thanks of the Institute be given to the Governors of Dalhousie College for the excellent accommodation afforded for the Meetings of the Institute for the present session.

Resolved, That the Institute record its expression of deep regret at the great loss that the Institute and science have sustained by the death of THOMAS BELT

ZOOLOGY.

MISCELLANEOUS.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART I.

Provincial Museum, Oct. 9, 1878.

ANNIVERSARY MEETING.

WILLIAM GOSSIP, ESQ., *Vice-President, in the Chair.*

Inter alia.

The following Gentlemen were elected Office-bearers and Council for the ensuing year:—

President—WILLIAM GOSSIP.

Vice-Presidents—FREDERICK ALLISON, A. M., PROF. G. LAWSON, Ph. D. LL. D.

Treasurer—W. C. SILVER.

Secretaries—PROF. D. HONEYMAN, D. C. L., JOHN T. MELLISH, A. M.

Council—J. B. GILPIN, B. A., M. D., M. R. C. S., PROF. A P. REID, M. D., PROF. J. SOMMERS, M. D., HON. L. G. POWER, JOHN MATTHEW JONES, M. L. S., ROBERT MORROW, AUGUSTUS ALLISON, ANDREW DEWAR.

Resolved, That the thanks of the Institute be expressed to the late President, Dr. J. B. GILPIN, for his able and efficient discharge of the duties of President, during his long tenure of office.

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F. G. S., M. E., "The Naturalist of Nicaragua," who was one of the Founders of the Institute, an active member, and a contributor to its Transactions.

The following notice of MR. BELT's death, appears in the Sept. 26, 1878, No. of "Nature," an illustrated Journal of Science, published in London:—

"The Scientific world will hear with regret the recent death of the well-known naturalist and geologist, Mr. Thomas Belt, F. G. S., which has just been telegraphed from Colorado. It is believed to have been caused by mountain fever. Elected a Fellow of the Geological Society in 1866, the geological world owes to him the division of the Lingula flags into Maentwrog, Ffestiniog, and Dolgelly flags, proposed in 1867. In 1874 appeared his well-known and deservedly popular "Naturalist in Nicaragua," in which he showed how his professional avocations as an engineer, had lent keenness to his observing faculties, and how an acute reasoner can utilize his observations. The work conveyed much information on protective mimicry, plant fertilisation, sexual selection, and the other collateral issues of the theory of evolution." * * *

DR. SOMMERS gave an interesting account of Observations "On Nova Scotian Mosses." Illustrative specimens were exhibited.

DR. LAWSON directed attention to a Communication from the Rev. E. BALL, Corresponding Member of the Institute, "On Certain Nova Scotian Ferns." The Communication was illustrated by specimens of Ferns from Dr. Lawson's Herbarium.

Mr. J. M. JONES gave an account of important additions made to the list of Nova Scotian Fishes, by the United States Fishery Commissioners. Mr. J. also intimated his intention to prepare a catalogue of the Fishes of Nova Scotia, as far as known, for publication in the Transactions of the present Session.

ORDINARY MEETING, DEC. 9, 1878.

The PRESIDENT *in the Chair.*

The SECRETARY announced that the Council had elected V. G. HARRIS a member, and WONG KIEN SHOON, of the Chinese Imperial Navy, on board of H. M. S. Bellerophon, an Associate Member of the Institute.

DR. HONEYMAN described and figured a new gigantic Trilobite from the Iron Mines of Clements, Annapolis County.

DR. SOMMERS read a letter from the REV. E. BALL, in reference to his observations on the varieties of *Aspidium Spinulosum*, Gray, which was communicated at a preceding meeting by DR. LAWSON.

"The Analysis of a new Mineral from Blomidon," by H. LOUIS, Assoc. R. S. M., was read by the SECRETARY.

An interesting specimen of fossiliferous sandstone was exhibited and described by the SECRETARY. The specimen was from Mira Ridge, Cape Breton. A letter was read from the Rev. Donald Sutherland, of Gabarus, describing the locality where he found the specimen.

ORDINARY MEETING, January 13, 1879.

The PRESIDENT *in the Chair.*

MR. J. M. JONES gave an interesting account of certain exotic fishes sometimes found on the Coast of Nova Scotia.

A paper "On the Geology of King's County," was read by DR. HONEYMAN.

ORDINARY MEETING, February 10, 1879.

The PRESIDENT *in the Chair.*

The SECRETARY announced that CHARLES R. F. TWINING, C. E., had been elected by the Council as a member of the Institute.

MR. EDWIN GILPIN, M. E., read a paper "On the Limonites and Limestones of Pictou County."

DR. J. B. GILPIN also read a paper "On the *Salmonidæ* of Nova Scotia." The paper was illustrated by numerous drawings and sketches.

The PRESIDENT announced the death of J. J. MACKENZIE, M. A., Ph. D., Professor of Physics in Dalhousie College, and a Member of the Institute. Dr. Mackenzie was a native of Pictou County, and studied at Dalhousie College, where he graduated as Bachelor of Arts in 1869, subsequently taking the higher degree of M. A. He afterwards proceeded to Europe, where he spent several years in studying at the Universities of Berlin, Liepzic and Paris. In Prof. Helmholtz's Physical Laboratory in Berlin, he conducted an elaborate series of investigations on the Absorption of Gases by Liquids, the results of which were published as a graduation thesis when he took the Degree of Doctor of Philosophy. His removal at an early age, when entering apparently upon a career of great public usefulness, is deplored as a great loss to Science.

ORDINARY MEETING, March 10, 1879.

The PRESIDENT *in the Chair.*

MR. HENRY LOUIS, Assoc. R. S. M., read a paper "On the Ankerite of Londonderry Mines."

The PRESIDENT communicated a paper by PRINCIPAL DAWSON, McGill College, Montreal, "On Nova Scotian Geology."

The *Communication* was the proof sheet of a reply to Dr. Honeyman's article in last year's Transactions, and intended for publication in the *Canadian Naturalist.*

ORDINARY MEETING, April 14, 1879.

The PRESIDENT *in the Chair.*

A paper "On Magnetism" was read by ANDREW DEWAR.

A paper was also read by DR. HONEYMAN, "Notes to Geological Retrospect of 1878-9."

ORDINARY MEETING, May 12, 1879.

The PRESIDENT *in the Chair.*

Before the Minutes were read the PRESIDENT referred to the loss the Institute had recently sustained by the decease of FREDERICK ALLISON, ESQ., after a lingering illness,—as follows:—

"MR. ALLISON had been a Member of the Institute for a number of years. At the time of his death he was one of its Vice-Presidents. He was a man of high character and attainments, M. A. of the University of King's, Windsor, and one of its Governors, and held the important position of Provincial Meteorolo-

gist, which he filled with honour to himself, and with entire satisfaction to the Government which appointed him to the office.

"In the Meteorological Section of the Institute he was conspicuous. He was an able successor of the late lamented Col. MYERS, to whom we were formerly much indebted for valuable services in that department of Natural Science. Our published Transactions attest the ability of both these gentlemen, and especially to that of Mr. ALLISON, who was an enthusiast in the study of the Science. The service he has rendered to Nova Scotia, and to the Dominion, by his Papers, which exhibit a continuous record for a series of years, of carefully observed atmospheric phenomena, and their influences upon the climate and vegetation of the country, cannot be too highly appreciated.

"Taken from us in the prime of life, an honorable gentleman, of unassuming demeanour, of whose friendship any one might be proud, an able advocate of science in general, and of high proficiency in a department which he had made his own, we sympathize in the sorrow of his relatives and friends in their bereavement; and lament the dispensation which has deprived us of an associate in every way worthy of our respect and esteem."

The Minutes of last Meeting were read.

The PRESIDENT directed attention to the following Communication received from the Royal Microscopical Society of London, in which it was proposed to constitute the President of the Institute, for the time being, a Fellow of the Society, and an exchange of publications was requested.

The Secretary Nova Scotian Institute.

6 *Old Jewry, London, E. C.,*
2nd April, 1879.

Dear Sir,

The Royal Microscopical Society have recently determined, as you will see from the enclosed report, to elect the Presidents of kindred Societies ex officio Fellows of this Society.

Your Society has been nominated under this regulation, and I shall be much obliged if you will inform me whether it will be agreeable to it to accept the nomination.

We shall be very pleased to receive your publications in exchange.

FRANK CRISP,
Secretary
Royal Microscopical Society.

The kindly intentions of the R. M. S. were acknowledged by the PRESIDENT, in a subsequent communication to the R. M. S., and the exchange of publications cordially acceded to.

A paper was read by J. T. MELLISH, A. M., "On Pisciculture."

The paper was illustrated by specimens of young salmon, hatched in the establishment at Bedford, superintended by Mr. Wilmot.

DR. SOMMERS read an interesting paper "On Microscopy."

Two excellent microscopes were used to illustrate his observations, with a good selection of objects—technical, geological and petrological.

DR. HONEYMAN exhibited geological specimens under the microscope, and DR. SOMMERS illustrated the circulation of the blood in the frog.

LIST OF MEMBERS.

Date of Admission.

1873. Jan. 11. Akins, T. B., D. C. L., Halifax.
69. Feb. 15. Allison, Augustus, Halifax.
77. Dec. 10. Bayne, Herbert E., Ph.D., High School, Halifax.
64. April 3. Bell, Joseph, High Sheriff, Halifax.
64. Nov. 7. Brown, C. E., Halifax.
75. Feb. 11. Brunton, Robt., Halifax.
78. Feb. 10. Brunton, John, Halifax.
78. Nov. 11. Cockburn, Lieut. Col.
67. Sept. 10. Cogswell, A. C., D. D. S., Halifax.
72. April 12. Costley, John, Dep. Pro. Secretary, Halifax.
63. May 13. Cramp, Rev. Dr., Wolfville.
75. Jan. 11. Dewar, Andrew, Architect, Halifax.
63. Oct. 26. DeWolfe, James R., M. D., L. R. C. S. E.
63. Dec. 7. Downs, Andw., Corr. Memb. Z. S., London, Halifax.
71. Nov. 29. Egan, T. J., Taxidermist, Halifax.
74. April 13. Forbes, John, Manager of Starr Works, Dartmouth.
72. Feb. 12. Foster, James, Barrister-at-Law, Dartmouth.
63. Jan. 5. Fraser, R. G., Chemist, Halifax.
78. Feb. 11. Geldert, J. M., Barrister at Law, Halifax.
73. April 11. Gilpin, Edwin, F. G. S., Inspector of Mines, Halifax.
60. Jan. 5. Gilpin, J. Bernard, M. D., M. R. C. S., Halifax.
63. Feb. 2. Gossip, Wm., F. R. M. S., *President*, Halifax.
63. Jan. 16. Haliburton, R. G., Barrister-at-Law, Halifax.
78. Dec. 9. Harris, V. E.
63. June 17. Hill, Hon. P. C., Barrister-at-Law, Halifax.
66. Dec. 3. Honeyman, Rev. David, D. C. L., *Secretary*, Halifax.
78. Feb. 11. Harrington, W. M., Halifax.
74. Dec. 10. Jack, Peter, Cashier of People's Bank, Halifax.
79. Jan. 11. James, Alex., Judge of Supreme Court, Halifax.
63. Jan. 5. Jones, J. M., F. L. S., Halifax,
66. Feb. 1. Kelly, John, Dep. Chief Com. Mines, Halifax.
77. Nov. 19. King, Major R. A., Halifax.
64. Mar. 7. Lawson, George, Ph.D., LL.D., Professor of Chemistry and Natural History, Dalhousie College, Halifax.
75. Jan. 11. Mellish, John T., M. A., *Secretary*, Halifax.
72. Feb. 5. McKay, Alex., Principal of Schools, Dartmouth.
77. Jan. 13. Morrow, Godfrey, Halifax.

66.	Feb.	3.	Morrow, James B., Halifax.
72.	Feb.	13.	Morrow, Robert, Halifax.
73.	Mar.	10.	Moseley, E., Dartmouth.
70.	Jan.	10.	Murphy, Martin, C. E., Provincial Engineer, Halifax.
65.	Aug.	29.	Nova Scotia, the Rt. Rev. Hibbert Binney, *Lord Bishop of.*
78.	Feb.	11.	Outram, Jos., Halifax.
72.	Nov.	11.	Poole, H. S., F. G. S., Superintendent Acadian Mines. Pictou.
76.	Jan.	20.	Power, Hon. L. G., Senator.
71.	Nov.	19.	Reid, A. P., M. D., Superintendent of Lunatic Asylum, Dartmouth.
66.	Jan.	8.	Rutherford, John, M. E., Halifax.
78.	Feb.	11.	Scott, Seymour, Halifax.
68.	Nov.	25.	Sinclair, John A., Halifax.
75.	Jan.	11.	Sommers, John, M. D., Halifax.
74.	April	11.	Sterling, W. Sawers, Cashier of Union Bank, Halifax.
79.	Feb.	10.	Twining, Charles R., C. E., Halifax.
66.	Mar.	18.	Young, Sir William, Knight, Chief Justice of Nova Scotia, Halifax.
77.	Jan.	13.	McGregor, J. G., A. M., D. Sc., Bristol, England.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
77.	May	14.	Burwash, Rev. Prof., Wesleyan College, Sackville, N. B.
75.	Nov.	9.	Kennedy, Professor, Acadia College, Wolfville.
78.	Feb.	11.	Louis, Henry, Assoc. R. Sch. of Mines, London.
75.	Jan.	11.	McKay, A. H., A. M., Principal of Pictou Academy.
75.	Nov.	9.	McKinnon, Rev. John, P. E. Island.
65.	Dec.	8.	Morton, Rev. John, Trinidad.
76.	Mar.	13.	Patterson, Rev. George, D. D., New Glasgow.

CORRESPONDING MEMBERS.

71.	Nov.	29.	Bell, Rev. E., Maccan.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
71.	Nov.	1.	Cope, Rev. J. C., President of the New Orleans Academy of Science.
70.	Oct.	27.	Harvey, Rev. Moses, St. John's, Nfld.
71.	Nov.	1.	King, Dr. V. C., Vice-President of the New Orleans Academy of Science.
71.	Oct.	11.	Marcou, Jules, Cambridge.
71.	Jan.	10.	Matthew, G. M., St. John, N. B.
72.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., &c., Mineralogist to H. M. the Queen and the Baroness Burdett Coutts.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. 1.—A CONTRIBUTION TOWARDS THE STUDY OF NOVA SCOTIAN MOSSES.—BY JOHN SOMMERS, M. D., *Professor of Psychology and Microscopy, Halifax Medical College; and Lecturer on Zoology in Technological Institute.*

(*Read November* 11, 1878.)

THE present contribution is a continuation of the study of N. S. Mosses, published in last year's Transactions.

It will be observed that both the present and previous papers exhibit a want of systematic arrangement, inasmuch as there will be found a repetition of genera and orders; a necessary result this of the manner of their preparation, and representing, as they do, the work of successive seasons, the species collected being various, their description as a whole will appear irregular, a difficulty which it is hoped will be overcome at a later stage by the formation of a catalogue of all the species described in these contributions.

ORDER NECKEREI. Mont.

NECKERA. pinnata. Hedw.

Stems pinnate flat, leaves ovate-lanceolate acuminate, nearly entire, nerveless sporangium ovate, oblong, immersed, growing on trunks of trees, fruiting in September.

ORD.—HYPNEI. Br. & Schimp, Mont.

HYPNUM. Schreiberi. Willd.

Leaves imbricated crowded, stems irregularly branched, the branches pinnate, sub-erect, sporangium oblong, ovate cernuous, lid conical, forming yellowish or golden green patches in pine woods, and on exposed banks very abundant, but rare in fruit;

the stems are of a beautiful shining red colour, the leaves are two nerved concave and obtuse, fruiting in Autumn.

H. BLANDOVII. Webb & Mohr.

Leaves ovate papillose, sharply toothed margins recurved, nerved to the top, stem divided, with paraphylla, branchlets crowded, sporangium curved cylindrical, lid conical apiculate.

A beautiful Moss, with many characters of Thuidium, forming dense cushions on rocks and stumps in bogs and swampy places, stems feathery, tall, pale green, sub-erect, fruit stalk long reddish common, fruiting in April and May.

H. SPLENDENS. Hedw.

Leaves imbricated, ovate, concave, serrated, pointed, two nerved sporangium, ovate cernuous lid, rostrate; stem sub-erect, more or less bipinnate or sometimes tripinnate, sporangium ovate cernuous lid beaked, common in damp woods, forming large tufts, fruitstalk tall, fruiting in early Spring.

H. TRIQUETRUM, L.

Stem ascending with fasciculate branches, stem-leaves squarrose, branch-leaves spreading, acuminate, cordate, serrate, two nerved sporangium, ovate cernuous. Forming coarse yellowish patches in exposed banks, generally occupying dry situations, fruiting in March and April.

H. CRISTA. castrensis, L.

Stem sub-erect, feathery leaves, secund ovate lanceolate, plicate acuminate, toothed two nerved below, sporangium curved, oblong, cernuous, lid conical. The most beautiful of our mosses, very common and easily distinguished, forming golden green patches on rocks in wooded hills, fruiting in July and August.

H. MOLLUSCUM. Hedw.

Leaves crowded, secund, serrate lanceolate, toothed acuminate, two nerved or nerveless; sporangium, ovate, short, lid conical, resembles crista castrensis in general appearance. The habit is smaller, sporangium smaller, lid more acute, the stems have not the abrupt termination of castrensis.

H. HAMULOSUM, *Frol.*

Leaves hamulose ovate lanceolate serrate, nerveless, stem procumbent pinnate sporangium, subcylindrical, lid conical acuminate, forming dark green patches, closely matted on rocks, and the boles of trees, bearing fruit in summer.

H. SCORPOIDES, L.

Stems procumbent, irregularly branched leaves imbricated, falcato secund, concave entire, nerveless or two nerved, sporangium, oblong curved cernuous, lid conical, beaked. Not common, in swampy woods, fruiting in spring and early summer.

H. ARCTICUM. Somm.

Stem creeping, branching irregularly, procumbent, branches, somewhat erect, leaves spreading, not squarrose, rigid entire nerved sporangium oval, cernuous, lid conical obtuse, forming dark green patches on rocks in running brooks, bearing fruit in May and during the Summer.

PYLAISIA. polyantha. Schimp.

Stem creeping, much branched, branches arched growing from the upper side of the stem, leaves secund turned upward, ovate acuminate, faintly two nerved or nerveless, entire, sporangium oblong, curved, fruitstalk long. Common on trunks and boles of trees, fruiting in September.

ORDER.—Drepanophyllei. Mont.

FISSIDENS. taxifolius. Hedw.

Leaves crowded, lanceolate, mucronate, margin crenulate, fruitstalk long radical, sporangium oblong cernuous, lid beaked. Bearing fruit in September. In moist woods common.

F. TAMARINDIFOLIUS. Donn.

Leaves short, distant, spreading, elliptic, bordered entire, apiculate, sporangium ovate, curved, lid conical, acuminate, fruitstalk arising from the base of the barren shoots, found in fruit in August, growing on roots of beech and other hardwood in damp woods, not so common as the last.

ORD.—BARTRAMIEI. Br. & Schimp.

BARTRAMIA. pomiformis. Hedw., var. crispa.

Leaves spreading, crisped, linear lanceolate toothed, sporangium on a short stalk globose, forming soft yellowish patches, very common on granite boulders, fruiting in April and May, the collections have a dessicated appearance due to the peculiarities of the leaves.

ORDER.—Bryei. Br. & Schimp.

MINUM. cuspidatum. Hedw.

Stem simple erect, lower leaves obovate, upper ovate lanceolate, both acuminate, sporangium pendulous oval, lid convex, obtuse, sporangium solitary, nerve not reaching the tip, fruiting in early summer, growing on the banks of water courses in shady places, sometimes in company with M. punctatum *loc.* woods back of Melville Island, ditto near Byers Road, D. Vill, Hx.

M. STELLARE, Hedw.

Leaves toothed, not bordered, stems erect sporangium cernuous, ovate, lid hemispherical obtuse, forming soft, deep green patches on moist, shady banks, leaves increasing in size from below upwards, fruitstalk long, arising from the midst of a budlike collection of leaves at the top of the stems, leaf cells smaller than in punctatum, bearing fruit in May and June. The leaves shrivel speedily in dry weather, when the fruitstalk and sporangium become the most prominent characteristics of the plant. Plants of this genus are the most beautiful objects of the whole Bryological series, presenting in their ordinary appearance the nearest approach to vascular plants. They are worthy of the attention of the horticulturist. Being very sensitive to atmospheric conditions, they require shade and moisture for their successful cultivation.

M. PUNCTATUM, Br., common on banks of shady brooks.

LEPTOBRYUM PYRIFORMI, Schimp.

Leaves lower lanceolate, entire, upper spreading toothed nerve, reaching the tip, sporangium large pearshaped, pendulous, lid convex, mamillary, common on turfy ground, roadsides, and places

exposed to sunlight, leaves inconspicuous, fruiting in early spring and through the summer.

ORDER.—Polytrichiei, Brid. & Sch.

POLYTRICHUM, commune, L., fruiting in June.

P. JUNIPIRINUM, Hedw., fruiting in June.

ATRICHUM, undulatum, P. Beauv., common, fruiting in autumn, forming dense green patches.

ORDER.—Tetraphidei, Br. & Schimp.

TETRAPHIS, pellucida, Hedw.

Very common in shady woods and on roots of trees, fruiting in summer and autumn, easily recognized by the four-toothed peristome and the cup-shaped cluster of leaves surrounding the gems.

ORDER.—Grimmiei, Br. & Schimp.

SCHISTIDIUM, maritimum, Br. & Schimp.

Leaves rigid, strongly acuminate nerve excurrent, much crowded erectopatent, sporangium obovato truncate, lid very large, shortly rostrate, fruiting in autumn, growing on granite boulders, dark olive green, pulvinate.

ORDER.—Hedwigiacei, Br. & Schimp.

HEDWIGIA, ciliata, Hook & Wils.

Branches fastigiate, leaves imbricated, oblong lanceolate, sporangium globose immersed, veil hairy perichætial leaves ciliated, lid plano convex, with a central papilla, variable, common on granite boulders, lurid green pulvinate, fruiting in autumn and through the winter.

ART II.—ON NOVA SCOTIAN FERNS.—BY REV. E. N. BALL, MACCAN, *Communicated by* DR. LAWSON.

(*Read November* 11, 1878.)

I HAVE been examining more closely the varieties of Aspidium Spinulosum (Gray) this Summer, and offer the following as my more matured observation.

ASPIDIUM SPINULOSUM (Gray).

Though in our Nova Scotian plants the scales cannot be said to be deciduous (for they are retained by the fronds even when past maturity), yet this fact will scarcely perhaps warrant my calling the indigenous plant a variety—obliquum, and, as the plant in all other respects answers to Gray's description, if I were to revise my paper, I should drop the idea of the variety and give it as Gray does.

A. spin. var. *intermedium.* Early in the Spring I noticed many plants of spinulosum so completely covered with glands as to render them, from this fact, markedly conspicuous to the naked eye even, and very distinct from other plants of same species, growing side by side with them in some instances, so that from a distance of 20 feet the unrolled glandulous fronds could be distinguished from the shining smooth ones. Marking several of these as yet undeveloped fronds, I find that the glandulous are intermedium and the smooth Gray's N. American typical Aspid. spinulosum. I had not noticed this to be the case before.

A. spin. var. *dilatatum.* This is a very distinctly marked variety. The fronds, by their broader growth, the pinnæ wider in the centre than at their bases, and at this season of the year, both in young and old plants, mottled with decay spots. But the most singular distinction is the long creeping rhizome, with the stumps of old fronds very stout, shorter than in var. intermedium and not overlapping so much. Intermedium has a more or less assurgent rhizome. The same characteristics *mark both young and old* plants, nor are these peculiarities owing to different habitats, for I find specimens of these two varieties most markedly distinct and yet with their rhizomes in contact with each other.

I have sent specimens of the three to the Halifax Nursery, and have asked Mr. Harris (the younger J. H.) to keep one of the roots of dilatata for you.

If you should deem this worthy of bringing to the notice of the Institute, with the rhizome and frond (from Minudie, Cumberland Co.) to illustrate, it is respectfully submitted.

What I have here stated is for the most part not new, but a confirmation of former notice.

ART. III.—A NEW MINERAL (LOUISITE), FROM BLOMIDON, N. S., BY H. LOUIS, *Assoc. Royal School of Mines, London.*

(Read December 9, 1878.)

H.=6.5 G. 2.41. Vitreous. Leek-green. Translucent. Streak and powder white. Fracture splintery. Brittle. Diff. B. B. In an open tube yields water and becomes pale brown. On platinum wire fuses to a white vesicular enamel.

It gelatinises in and is completely decomposed by hydrochloric acid.

ANALYSIS.

$Si\,O_2$	63.74
$Al_2\,O_3$	0.57
$Fe\,O$	1.25
$Mn\,O$	trace
$Ca\,O$	17.27
$Mg\,O$	0.38
$K_2\,O$	3.38
$Na_2\,O$	0.08
$H_2\,O$	12.96
	99.63

The formula appears to be, $12\,Si\,O_2\;4\,Ca\,O\;9\,H_2\,O$ or perhaps, $3\,Si\,O_2\;Ca\,O\;2\,H_2\,O$.

Considering the water as basic, the latter formula may be written. $3\,Si\,O_2\;R\,O.\;2\,M_2\,O$ where $R\,O=Ca\,O\;Fe\,O\;Mg\,O$ and $Mg\,O=H_2\,O\;K_2\,O\;Na_2\,O$.

The latter is, I think, the better view to take of its composition.

NOTE.—The Mineral was picked up by Mr. Robert Starr, of Cornwallis, when I was examining the Geology of Blomidon. I have suggested the name Louisite, in consideration of Mr. Louis's kindness in undertaking to analyse it. Prof. Dana remarks in reference to its composition, that if all the silica in it is combined, and none of it free, there is nothing like it in mineralogy.—Mr. Louis says that the silica is all combined.

Mr. Louis exhibited a beautiful specimen of Crystallization in

a tap-cinder from Londonderry Iron Mines. The multitude of Crystals thus formed are considered to be *Olivine.*

D. H.

ART. IV.—NOVA SCOTIAN GEOLOGY. BY THE REV. D. HONEYMAN, D. C. L., *Fellow of the University of Halifax, Curator of the Provincial Museum, Professor of Geology in Dalhousie College and University, and Lecturer on Geology in the Technological Institute.*

(*Read Dec.* 9, 1878,)

I HAVE received from the Rev. D. Sutherland, of Gabarus, (near Louisburg,) Cape Breton, an interesting specimen of fossiliferous sandstone. The locality where he found it is described as "At a fine spring of water that boils up out of the rock, at the roadside, on A. Walker's farm, Big Ridge, on the road from Marion Bridge, (Mira River,) to Gabarus, at about $1\frac{1}{4}$ miles, as laid down on Church's map, direct south from Marion Bridge." I have referred to Marion Bridge in my "Retrospect" of last session as the locality where Mr. H. Fletcher, of the Dominion Geological Survey, discovered interesting fossiliferous strata, which I referred to the horizon of the *Upper Lingula Flags of Wales,* on account of the occurrence of the Trilobite *Olenus alatus,* associated with *Agnostus.* Mr. Sutherland's specimen of fossiliferous sandstone indicates the width of a fossiliferous band $1\frac{1}{4}$ miles. If the series descends towards Gabarus, we may now have reached the horizon of the *Lower Lingula Flags.* The specimen of sandstone before me measures $2\frac{1}{4}$ x 3 inches; its thickness is from 5 to 4 tenths of an inch; it is metamorphic and subcrystalline. One of the sides is weathered; the other is fresh; both are covered with fossils. On the fresh side they are very beautiful. The forms are *Lingulellæ.* They are acuminate and subcircular. The acuminate forms range from a length $\frac{1}{10}$ and a width $\frac{3}{40}$ to $\frac{10}{40}$ in length and $\frac{7}{40}$ in width. The subcircular are in the proportion of $\frac{6}{40}$ to $\frac{5}{40}$; one appears to be circular, $\frac{3}{40}$ in diameter.

*Mr. Sutherland has sent to me, two other specimens. One is a

* May 10, 1879.

piece of sandstone from the same strata as the preceding. This has on one side *impressions* of *Lingulellæ*, which might be questioned as such if not associated with those I have already described. The rock itself is interesting; its edges are coated with microscopic crystals of quartz, and the whole might be designated a *quartzite.* The second specimen is a piece of argillite having *four* fossils of larger dimensions than those just described.

Mr. Sutherland found this specimen in the rock, on the same Ridge, (Mira,) a mile nearer Gabarus, than the *Lingullela* sandstone. One of the specimens has fine concentric lines, which another shows to be lines of growth. They are inequilateral. Their length exceeds their width in the proportion of 4 to 3. The length of two of the specimens is $\frac{6}{10}$; of another, $\frac{4}{10}$. There are no muscular or pallial impressions. We have thus evidence of the existence of a fossiliferous band of $2\frac{1}{4}$ miles in width extending from Marion Bridge, southwards, towards Gabarus, and intervening between the carboniferous of Mira and the crystalline and subcrystalline rocks of Gabarus.

Mr. Sutherland has also sent a specimen from Gabarus, in which are forms, which might be mistaken for fossils.

These discoveries of Mr. Sutherland's are very interesting, in consequence of their approach to the Louisburg and Gabarus rocks. Some of which have been referred by the Geological Survey of Canada to "Snowdon and Cader Idris, volcanic accumulations," and to the Huronian age of Canada. I have elsewhere referred them to my "Middle Arisaig Series," *i. e.* Cambrian.

My investigations in Annapolis and King's Counties, vide papers *last* Session and *this* (next paper), have directed my attention to a specimen in the "Webster Collection," of the Provincial Museum.

When I received and arranged this collection some years ago, I found in it a slab of sandstone thickly studded with *Lingulellae* I then considered it as a Potsdam Sandstone rock and placed it in the lowest position in the collection, as "Acadian Geology" led me to infer nothing lower in the collection than Niagara Limestones. I also concluded that the specimen was *not Novæ*

Scotian. My own investigations and conclusions regarding the Geology of Kings and Annapolis in connection with the discoveries of Mr. Fletcher, of the Geological Survey of Canada, and the Rev. D. Sutherland in Cape Breton, just noticed, have led me to suspect that the specimen after all is Nova Scotian, and that possibly it belongs to Kings County, and is indicative of the existence of rocks of the Potsdam formation in this region. An examination of the specimen seems to indicate; 1st. That it was not found *in situ* but was a section of a boulder. 2nd. That it came from a region where granites or gnessoid rocks exist. The side of the specimen with fewest fossils is rather micaceous. In this it differs from the Mira specimen. It is also less hardened, the Mira specimen being subcrystalline.

The *Lingulellae* of both are identical, even the proportions are nearly the same. The *Lingulellae* of the Webster specimen measure from $\frac{4}{40}$ to $\frac{11}{40}$ of an inch. Their forms are generally acuminate.

A New Trilobite.

Asaphus ditmarsiae (N. Sp.)

The specimen is a pygidium. Width 5.8 inches; the length about 5.4 inches. It is semi-oval and gibbous.

The mesial lobe is rounded and tapering. It is fragmentary and partly indistinct. Its apex is semi-oval. $4\frac{3}{4}$ inches of the lobe remains. At the top it is *two* inches wide; $3\frac{1}{2}$ inches from the top the width is $1\frac{1}{4}$ inches; there is one almost entire ridge at the top and two parts succeeding, having portions of two intermediate furrows, the apical part is in length $1\frac{3}{4}$ inches.

Side lobes. The left is lengthened *one inch* by *distortion.* The right appears to be unchanged. Each lobe has 8 ribs with deep intermediate furrows. The ribs when regular are strong and rounded, and extend the whole width of the lobes as far as the margin. The upper one of the left lobe is bevelled, and has a flat *pleuron* of the thorax attached, its surface is also granulated. This lobe has a short and narrow supplementary rib next the apex, the corresponding one is obscure. On the right lobe four of the ribs are widened and flattened. A smooth and slightly convex margin, 4-10 of an inch in width, is round the left

lobe. It partially remains on the right. It is wanting, having been broken off the apex. The whole trilobite, if proportioned like the *Isotelus gigas* must have been 1 foot 3 inches in length. There accompanies, the cheek of a smaller individual, nearly resembling that of *Asaphus gigas*. The fragment of rock in which it is imbedded is heavy in proportion to its size, in consequence of the iron which it contains. It is *Magnetite*. Dr. J. B. Gilpin, to whose kindness I am indebted for the specimen, informs me that it was found in the Iron Mines of Clements, Annapolis Co. At his suggestion I have named it after Mrs. Laura Ditmars, who secured it from the collection. This is by far the largest member of the trilobite family that has yet been discovered in Nova Scotia. It is one of the *Anakim* of the Silurian period. I shall quote authorities to show the distribution and range in time of the *Family Asaphidae*.

ENGLAND.—*Murchison.*

"The genera *Trinucleus*, *Asaphus* and *Ogygia*, are never detected, even in the lowest part, of the Wenlock group, therefore, being essentially characteristic of the Lower Silurian rocks." —Siluria, 1872, page 114.

Salter.

Asaphidae, a large unwieldy group of great trilobites, which are characteristic *strictly* of Lower Silurian rocks. The exceptions to this geological position are *very rare*. Except *Illænus* it does not rise out of the Lower Silurian, and it is *very rare* even in Llandovery or *Middle Silurian rocks*. *Niobe*, *Prilocephalus*, *Asaphus*, *Ogygia* and their *sub-genera*; one or other of these *genera* are characteristic of every locality where Tremadoc, Llandeilo, or Caradoc strata are found.

Asaphus or *Isotelus* is the largest, excepting of course *Paradoxides*, among the *Olenidae*. Ramsay's Geology of North Wales, page 310.

BOHEMIA.—*Barrande.*

Trilobites.

"Fannes Siluriennes—Distribution verticale des Trilobites en Boheme.

Groupe II. D. *Asaphus*, d 1, 3, d 2, 1, d 3, 1, d 4, 1, d 5, 1.

Asaphus ingens *Carr.*, d 2.

Asaphus nobilis, *Barrande*, d 1, d 3, d 4, d 5, totaux, 7 especes."

The genus does not appear at all in Groupe II. Divs. E. F. G. H. They are all Lower Silurian forms in Bohemia.

AMERICA—HALL.

"We have a sufficient number of Trilobites identical with those of the Silurian rocks of Europe to institute a comparison of the correlation of the ancient ocean in both hemispheres.

That remarkable and characteristic Lower Silurian form, Trinucleus, is among the most common, while Illænus and Isotelus or Asaphus, no less characteristic, are obtained in the earliest limestone."

Palæontology of New York, Vol. I., page 21.

Isotelus gigas. DeKay. Chazy Limestone. Trenton Limestone. Utica Slate. Hudson River group (all Lower Silurian). Table of Species, page 529.

Meek.

Asaphus (Isotelus), megistus ?

Palæontology of Ohio.

Fossils of Cincinnati Group, page 139.

Miller.

Asaphus (Isotelus gigas).

DeKay, 1825. Ann. Lic. Nat. Hist. N. G., Vol. 1. Trenton and Hudson River Gr.

Isotelus megistus, Locke, 1841. Proc. Am. Asoc. Trenton and Hudson River Gr.

Miller's American Palæozoic Fossils.

Cincinnati, Ohio, 1817.

Canada—Billings.

Geology of Canada, 1863.

Catalogue of Lower Silurian Fossils of Canada.

Asaphus megistus. Black River. Bird's Eye. Trenton, Hudson River (Lower Silurian) and *Middle Silurian.*

Asaphus platycephalus. Chazy. Black River. Bird's Eye. Trenton. Utica. Hudson River. (Lower Silurian.)

In England and Canada the genus Asaphus rises into the *Middle Silurian.*

It is not known to appear higher, not even in the Upper Silurian, *much less in the Devonian.*

The *pygidium* of a small *asaphus* occurs in the Wentworth, I. C. R., strata. *Museum Collection.*

ART. V.—NOVA SCOTIAN GEOLOGY—KING'S COUNTY.—BY THE REV. D. HONEYMAN, D. C. L., *Curator of the Provincial Museum, &c.*

(*Read January* 3, 1879.)

INTRODUCTION.

One morning in June, 1877, I left Halifax with the determination of making an intimate acquaintance with the rocks of King's County. Arriving by the train at the Wolfville station, I took the direct road, past Acadia College, to the high land, with the expectation of meeting with rock exposures. I took a passing look at the amygdaloid boulders in the drain, regarding them as the possible fellow travellers of our Halifax drift acquaintances. Reaching the height above Wolfville, I was gratified to find a good exposure of solid strata. Standing on these rocks, I deferred operations until I had admired the interesting scenery in view. Below lies old Acadia College, the beautiful Town of Wolfville, and *Grand Pre,* of Evangeline fame, with its brilliant garb of summer green. Beyond stretches Cornwallis, with its serpentine streams, its fertile fields, and numerous villages. Towering on the north is North mountain, with Blomidon looming and advancing into the Minas Basin, hiding the Minas Channel, Cape D'Or, and Cape Chignecto. This fine sheet of water, bounding Grand Pre and Cornwallis, extends to the distant north as Minas Basin and Cobequid Bay. The Cobequid range of Cumberland and Colchester rising to the dim distance beyond.

Having thus indicated the sphere of our operations, and our first starting point, I shall arrange my remarks on these operations under three comprehensive divisions:—

1. Pre-carboniferous,
2. Carboniferous,
3. Post-carboniferous.

1. The examinations, as far as made, divided the pre-carboniferous formations into two areas, viz.: the Wolfville and Kentville, the two respective starting points of the examinations made.

The 1st area is about 20 square miles in extent. Its N. E. corner lies in Wolfville; its N. W. at the entrance of the Deep Hollow road. The distance between these two points is 3¼ miles. The S. E. corner is at Vaughan's Mill, Greenfield, on the Halfway River, *Church's map*. The S. W. corner is at Bezanson's Mills, on the Black River. The distance between these two points is about 3 miles. Greenfield is about 5 miles distant from Wolfville. The greatest width of the area is about 2½ miles from Wolfville, south, and 5 miles west of the falls of Black River, where the pre-carboniferous and carboniferous appear in close connection, on the Halfway River road and side of the mountain. The rocks in this area are largely obscured, still, there are many and interesting exposures around Wolfville and in the Deep Hollow road. In certain elevated positions, and in the Gaspereaux River, Black River, and Halfway River, the great desideratum is the evidence of fossils. None were observed in this area although strictly searched for. Lithological evidence of age and diversity of formation was all that was observed. This seemed to divide the rocks into two series. At Vaughan's Mill and Bezanson's Mill, and on the road intervening, the exposures seemed to indicate Upper Cambrian age. The exposures around Wolfville, the Deep Hollow section, and sides of the Gaspereaux River, the Falls of Black River, and outcrops farther up the river, seem to indicate another, probably Lower Silurian.

The whole aspect of the rocks at Wolfville is so different from anything that I had observed elsewhere, that I was altogether perplexed. The rocks are Argillites, grey and red, in a state of metamorphism more decided than any Middle or Upper Silurian in Antigonish, Pictou, or Colchester. They approximate so

nearly to the Argillites of Halifax in all but colour, that I felt disposed to refer them provisionally to the same age. The tilting and obscure stratification, the occurrence of large crystals of pyrite and quartz veins, here and elsewhere, as in the Deep Hollow, seemed to favor this view. The only seeming doubtful feature was the occurrence of Diorites in the Deep Hollow. The great quartzites at the meeting of the Deep Hollow and Gaspereaux roads, near the great saw mills; the quarries in these great beds; the various blocks of quartzite dislodged; the beautiful dendritic and moss-like figuring in the cleavage joints, even more striking than in the Halifax quartzite;—all tended to deepen the first impression.

The magnificent exposure of rocks of the Falls of Black River presented another aspect, which tended to confuse and unsettle in reference to the age of the preceding. My usual good fortune failed me in the examination of this area. How welcome would have been the sight of a familiar fossil. I came to regard a search as hopeless as in the slates of Halifax itself. I am under great obligations for guidance to the Deep Hollow and Falls of Black River, as well as to other localities, to Mr. Robert Starr, of Starr's Point, Cornwallis.

On consulting Church's Map, I observed certain saw-mills considerably back in the County. Mr. Thomas DeWolf, of Wolfville, kindly undertook to guide me to these localities. Traversing the old mountain road to Half-way River and Windsor, we entered the area about the middle where the Pre-carboniferous and Carboniferous areas meet (already referred to). Here we found a great exposure of Black Argillites of very ambiguous character. Before reaching Half-way River we found ourselves in the Carboniferous areas—a considerable outcrop of sandstones appearing on the road with Carboniferous *flora*.

We evidently continued in this area as far as Half-way River and the County line. Taking the road leading up the river, we came to *Bezanson's Mill*, where nothing particular was observed except large masses of granite. On reaching *Willet's Saw-mill*, we observed a section of Carboniferous strata on the right side of the road. After this we observed nothing but drift, we

seemed, however, to have re-entered the Pre-carboniferous area. Reaching *Vaughan's Mill, Greenfield*, we found a magnificent exposure of pre-carboniferous rocks, having lithological characters widely different from the other rocks of the area. The resemblance of these to the black argillites of Halifax and Dartmouth, is sufficiently obvious. I felt no hesitation in regarding them as the north side of the great Cambrian series of our gold fields. Looking to the heights beyond we observed massive granites which *seemed* to indicate solid granite *underneath*. Traversing these in passing on from Vaughan's Mill to Bezanson's Mill, on Black River below the lake, we found outcrops of black argillites, the enormous and frequent occurring blocks of granite being only transported rocks, derived from granite outside of area, and not yet examined. At *Bezanson's Mill* the black argillites were seen outcropping. Gneissoid and granite specimens were collected from rocks not in situ—precisely like the Halifax—granite and gneissoid rocks.

We then followed nearly the course of the Black River, observing the fine exposure of argillites at Payzant's Mill, and occasional outcrops between this and the Falls. Before reaching the Falls we ascended the mountains on the right observing occurring outcrops of metamorphic rocks, and thus crossed the area to its border at Gaspereaux River Bridge. We then proceeded along the road that leads up the river, on the Wolfville side, towards the Deep Hollow, observing the extent of the quartzites already referred to. We passed through the Deep Hollow and emerged from the area described at its N. W. Corner. This examination led to the conclusion that there are two series of pre-carboniferous rocks in the area, viz.: Cambrian and Lower Silurian, which may be locally characterized as *Greenfield, Wolfville*.

The second area examined is about ¼ of the size of the preceding one and much more irregular. It begins at Kentville, the first strata being exposed at the mills, a little above the bridge, on the side and in the bed of the brook. At the great dam a little farther up, they are considerably exposed on either side; a little above this they disappear in the brook giving place to outcrops of another formation. They are again seen in a limited section

on the Beech Hill road. This shews that the high ground on the right is formed by these pre-carboniferous rocks. Above the bridge the continuation of these rocks is manifest by the exposure in the bed and sides of the brook, and in outcrops on the high lands on the right. Below the bridge are several branches of the brook, the most important has two falls, the lower and upper, the one at Mr. Webster's farm, the other near the summit of the height of New Canaan.

The rocks of the area are slates and shales with occasional arenaceous beds. Their colouring is sufficiently varied, sometimes it is beautiful and ornamental. The colours are red, yellow, fawn coloured, black and grey. They are not so highly metamorphic as the rocks of the preceding area, and their stratification is more obvious. There are also fossils in one member of the series. In the brook at Kentville some of the strata are yellow with beautiful red, wavy lines, having the appearance of woody structure (pine). At the dam the slates are black and deep red (ochrey) with occasional green, being coloured by films of carbonate of copper. At Webster Falls there is a set of fawn coloured slates of considerable thickness, having sandy strata with a vesicular structure. I was fortunate enough to come upon a part of the fawn slates having *Dictyonema Websteri* (Hall), named after the discoverer, the late Dr. Webster. The strata of the Upper Falls are black slates, almost like roofing slate. The height and arrangement of the strata must form a beautiful waterfall when the brook is well filled with water.

The Dictyonema and other strata of the area have been referred to the Niagara Limestones (Upper Silurian Period), on the slender palæontological grounds of *Dictyonema* occurrence. Others are disposed to regard this as an evidence of Lower Silurian age, so that the age of the rocks of this area may also be regarded as doubtful. I have not observed any unquestionable Upper Silurian rocks of similar aspect. In Cape Breton *Dictyonema* is a Lower Silurian form, the same is the case at Quebec. It occurs in the Upper Lingula Flags of Wales. The revelations of Nictaux and the occurrence of *Asaphus ditmarsiae* at Clement's tend to shake faith in received opinions. The

Diorites noticed are regarded like the Nictaux Division, as of Devonian age.

2. *Carboniferous.*—The carboniferous area of this county is about 25 square miles in extent. Its first appearance on the west is at Wolfville, where it is found overlying rocks of the pre-carboniferous area. Its next appearance is at the back of Wolfville where it is well seen on the road to Gaspereaux and in an adjoining hollow. The strata here are very coarse grits, overlying the pre-carboniferous argillites. It next appears in the Gaspereaux River at the bridge adjoining pre-carboniferous rocks. I have already noticed its next appearance on the mountain road, where the rocks are coarse grits overlying pre-carboniferous argillites. Its next appearance is at *Willet's Mill,* where the pre-carboniferous strata are observed. It is thus only seen in contact with the Wolfville series. On the old mountain road sandstones have already been observed. Geologically higher than the strata in contact. These show the formation to be carboniferous by the *debris* of fossil flora. Higher in the area outcrops of grits and sandstones are of frequent occurrence and sandstones extensive, but uninteresting. When we reach within a mile of the shore of the estuary of the Avon, outcrops of black shales appear, and on the shore about five miles distant from the junction of the pre-carboniferous and carboniferous, there is a magnificent section—Horton Bluff and Blue Beech. This section is lofty and extensive, in common with sections on the Minas Basin shores, it is sharp and comparatively free of debris. Here I found sandstones with *matted kelp* surface. Clay-ironstone and abundance of beautifully shaped Septaria, Fossil Flora, Lepidodendra and Stigmaria and Sporangites, Fauna, Reptilian footprints, scales and teeth of *Palæoniscus,* and a half of the lower jaw of *Palæoniscus* with teeth in place. No carboniferous strata were observed west of the point indicated at Wolfville. Still it is possible that concealed or overlapped strata may exist in the valley. During the Carboniferous period there was no North Mountain or Blomidon narrowing the Bay of Fundy. It then extended as far as the Wolfville, Kentville and Nictaux pre-carboniferous, or nearly so. Conditions similar to those now existing in the Bay of

Fundy seem then to have prevailed. Conditions rather favourable to the denudation of shores, than for the accumulation of *littoral deposits.* The first littoral check given to the sweep of the waters seems to have been the pre-carboniferous rocks of Wolfville, which seem to have been a cape of the Carboniferous period. This seems to have been favourable to a coarse sandy accumulation (Grit), while at the same time the Cobequids had a shingle forming shore (Conglomerate).

3. *Post Carboniferous.*—Triassic Sandstones, &c., occupy the area north of the pre-carboniferous from Wolfville westward. They are first observed at the united corner of the Carboniferous area. Here they are seen overlying the carboniferous strata, at no great distance they are then seen at Jessup's; directly overlying pre-carboniferous argillites without the intervention of the carboniferous. These overlying strata are loose and incoherent, wanting the compactness of the carboniferous strata, and not much different in appearance from banks of drift. At *Elderkin Brook,* near Kentville, a fine section is seen on the site of a saw-mill. On the west side of the Dam up Kentville Brook a fine exposure is seen of the same formation, overlying the ochreous and copper coloured slates described in this locality. They reappear up the Brook at the Shooting Range, and make an occasional appearance as far up as the mouth of the Webster Falls tributary. At *Elderkin Brook* they appear in their characteristic manner, soft, sandy strata of decided red colour. The east side of the area is beautifully exposed in sharp and clean sections from Starr's Point onward to the extremity of Blomidon. The north side is seen rising to the brow of North Mountain and terminating with Blomidon on the east (apparently). In this area conglomerates similar to the lower beds of the Cobequid Triassic do not appear, and the compactness of bedding which make the sandstones of the latter available for building purposes, is notably wanting. At Starr's point the beds contain veins of calcareous spar, some of these are of considerable thickness. Crystals are of sufficient size and transparency to shew the phenomena of double refraction. At Blomidon foot were observed considerable masses of selenite and fibrous gypsum dislodged from the Triassic

sandstones. Irregular beds of impure manganese were seen in a road section near Starr's Point. The red colour of these sandstones are an obvious feature. Theories have been indulged in to account for its existence. At the close of the Carboniferous period conditions of deposition appear to have changed, so as to favour the formation of the Triassic sandstones at Kentville and elsewhere, but not so as to form conglomerate as in the Triassic of the Cobequids. The pre-carboniferous area of Kentville seems to have formed a breakwater in the Triassic Period.

4. *Trappean Area.*—My acquaintance with this area is derived from the Blomidon cape and shore, a traverse from Lower Pereau to Scott's Bay, an examination of the rocks on the shore of Scott's Bay, and a return with a diversion leading to the junction of the Ross Creek Road (Church's Map). The rocks observed are Basalt, Trap, Amygdaloid and Ash. Among the fragments of Basaltic rocks on the Blomidon shores the prismatic structure is of frequent occurrence. The Amygdaloids correspond with the boulders abounding in our superficial drift. Ashy beds are represented by boulders occurring in the same drift. Minerals from the Amygdaloid traps of Blomidon collected are, Jaspers in great variety, Agates, Mesolite and Natrolite. These are of usual occurrence. A specimen found here is the *new mineral, Louisite.* At Scott's Bay, in the Trap, were collected Agates, Jaspers, Amethysts and Natrolite. Fine specimens were rare in this locality; Mr. Steele, the local collector, being on the constant look out for choice minerals. In his collections were seen, besides beautiful agates from this locality, an exquisite collection of varieties of Natrolite, many of them of rare beauty, and the striking mushroom like Mordenite var. Steelite (How) with bristling Stilbite). They were collected at Cape Split. They subsequently came into the possession of Professor How, who has given a good account of them.

Some of these have found their way to the Provincial Museum. The Webster collection in the Museum fully represent the minerals of Blomidon. We often designate these igneous rocks as of Triassic age. As they are intrusive they might be called *Post Triassic* rocks, as it seems a rather difficult matter to prove their age.

5. *Post Pliocene.*—The boulders of Amygdaloid in the drift cutting east of Acadia College, Wolfville, have already been referred to. In the hollow over against the Gaspereaux Valley, at the junction of the Pre-carboniferous and Carboniferous strata already noticed, the occurrence of similar boulders was so striking, that it appeared as if the rocks must be *in situ*. In the Gaspereaux Valley they were seen in sufficient abundance. I also discovered them at Greenfield on the Halfway River. There is no doubt but that they are to be found in intermediate drift, if looked for. Mr. Ellershousen informed me that they occurred in the drift at Ardoise. They are to be found all along in the drift cuttings of the Windsor Railway. In previous paper, "On the Superficial Geology of Halifax Co,"—*Transactions*, 1876-7—I pointed them out in great abundance in the drift cuttings between the Beaver Bank Station and the Windsor Junction. At the Windsor Junction they are found in abundance at the drift. They occur in the drift at Bedford, in the Navy Island, in Bedford Basin, in the drift cuttings at Richmond, in the Citadel Hill, in the Dartmouth drift beds, in George's Island, McNab's Island, Point Pleasant; apparently at Ketch Harbor, Sambro, Devil's Island, and along the Eastern shore as far as Three Fathom Harbor. Thus notably has the Blomidon area of rocks suffered from the exactions of post trappean and post pliocene agencies. Its height must therefore have been considerably greater than we now find it. The sandstone of the valley must have risen to a greater elevation than at present, forming a highway for the transit of the mountain *debris*, the valley having been subsequently formed, and the pathway destroyed. The remains of these sandstones on the sides of the Trappean area, and the sections on the shore, running almost on a level with the Trap elevation, as well as the elevation of the drift on the south side of the valley, tend to prove the former existence of this highway. If Minas Basin then existed, its boundaries must have differed greatly from those now apparent. The creeks and sections of new red Sandstone now extending between Blomidon and *Grand Pre* were unformed, and the Estuary of the Avon unknown. These were doubtless exten-

sions of the great highway. Even the new red Sandstone of the Minas Basin itself, between the Cobequids and Hants, was not exempted from similar service, as the extensive Syenite transported to the Atlantic coast in like manner indicates. "That all parts of the valley were considerably elevated is evident from the appearance of Cleveland Mountain, Nictaux, and the Nictaux and Atlantic Railway sections. In these drift sections we have Amygdaloids from the North Mountain, and on the northern edge of the Cleveland Mountain, at the junction of the new and old road I observed a beautifully polished and striated surface of strata at an elevation equal to the greatest height of North Mountain, indicating the elevation of the former sandstone highway over which the amygdaloids of the railway drift must have passed.

Last of all, I would notice another transportation which may have happened in this period, at its close.

I have already referred to the enormous and abundant masses of Granite observed at Halfway River and on the heights at Greenfield. These have apparently been transported in N. E. direction, while the amygdaloid transportation has been to the S. E. A similar occurrence of granites was observed at Nictaux. Restoring all the material referred to as transported in pre-post-pliocene, post-trappean and post-pliocene time, as well as more recently, I would connect, widen and heighten the trappean regions of North Mountain, Digby Neck, Long Island, and Briar Island. I would also connect these with Isle Haute, Cape D'Or, Partridge Island, Parrsboro, Two Islands, Five Islands, thereby closing up the Minas Channel between Cape Split and Cape D'Or, and bridging the space between the North Mountains and the Cobequids. I would fill up Annapolis Valley and the Minas Basin and Cobequid Bay. I would increase the bulk and possibly heighten the Cobequids. I would contract the Bay of Fundy by connecting the red sandstones of Quaco with those of Nova Scotia. Pre and post-pliocene agencies, especially the latter, are then set to work transporting and effecting changes. At the close of the pre-pliocene period, the Annapolis Valley, the Basin of Minas and Cobequid Bay are formed, and

the existing agencies generally commence their work. At the close of the post-pliocene period, and the scooping of the Annapolis Valley, the granite transportation may have been effected.

ART. VI.—THE LIMONITE AND LIMESTONES OF PICTOU COUNTY, N. S.—BY EDWIN GILPIN, A. M., F. G. S.

(*Read Feb.* 10, 1879.)

I PURPOSE this evening laying before you a few notes on the Limonite or Brown Iron ores of Pictou County, their source and relation to the associated Limestones; and, from the information at my disposal, to show that there is a possibility of these ores and their derivatives being much more widely spread than is generally considered to be the case; and in connection with the supposed sources of these ores, I will briefly draw your attention to the great dynamic changes in the district, which have generally been overlooked, and which have played an important part in the formation of the Limonite.

The most superficial student of Geology can hardly avoid a correct conjecture at the comparative ages of the strata he passes over in this county. Were the turf and wood removed from the ground, a bird's eye view would present each formation, colored by the hand of the Great Architect, and showing in its covering of soil the materials it is composed of.

The light sandy soil of the Upper, or (as it has been called), the Permo Carboniferous, the clays of the Coal measures, the reddish loam of the Lower Carboniferous, and the meagre boulder laden clays of the Silurian, all mark, with an interval of a few yards, the passage from one set of measures to another.

In an equal degree, the valley of the East River, above Springville, spreads before the traveller the distinctive landscape, marking the contact of two dissimilar rock systems. On the one hand the Silurian hills rise abruptly three or four hundred feet above the River, projecting here and there in bare, weather-worn knolls, or covered with a dense growth of gnarled birch and maple, and showing in places farms which have ill repaid the husbandman's labour. On the other hand, the Lower

Carboniferous measures rise to a lesser height, in gentle undulations, and present a pleasing succession of well cultivated fields, backed by the dark wall of the hemlock and spruce woods.

Between these two landscapes, so widely differing, runs the East River in graceful curves, presenting alike to each broad elm shaded intervale, as if desirous of hiding the fact that ages ago it must have cut its channel chiefly in the softer Carboniferous measures.

However, we must leave these lighter studies of the Geologist, and confine ourselves to the more prosaic subject of Iron ores and Limestones.

On entering the County of Pictou by the Intercolonial Railway, the Lower Carboniferous are met near Glengarry Station, and from that point their line of contact with the Silurian runs in a general N. E. course, toward the Gulf, with a long funnel-shaped arm following the valley of the east branch of the East River, toward the south.

The Lower Carboniferous measures of Pictou County, as met in the various natural exposures, are largely made up of highly arenaceous red shales, breaking with a conchoidal uneven fracture, and seldom holding fossils. These shales pass on one hand into massive bedded white and grey Sandstones, yielding many fragments of Carbonized plants, and on the other, into fine fissile clays, frequently calcareous, full of fossils, and holding nodular bands of impure Limestone. There are also beds of Gypsum, red and purple marls, and Limestones of various thickness and purity, and a few beds of black bituminous shales.

At one point these measures are penetrated by Diorite dykes, and in many places the traces of metamorphic action are shown by veins of specular ore.

Conglomerates are rare in the district more immediately under consideration, and one insensibly imagines that the beds belonging to the shores of the Lower Carboniferous ocean have all been in great measure swept off.

These measures rest unconformably on the edges of the Silurian strata, with a general dip varying from N. E. to N. W., or away from the older rocks. This inclination is preserved, with occa-

sional undulations, until they pass beneath the later members of the same group, in the vicinity of Stellarton and New Glasgow.

One is at once struck, when examining the sections of the Pictou Carboniferous, by the tremendous denudation they have been subjected to, which has dwarfed the Pictou Coal field to a tithe of its original dimensions, and in many places bared the Silurian rocks, which were once covered by thousands of feet of later formed strata. We find that the summits of anticlinals have been swept away, and that in places whole synclinal troughs have disappeared.

The two following instances of this denudation are presented as examples of what has been going on all over the county.

Thus, in the Pictou Coal field, we have in one section a breadth of outcrop corresponding to a thickness of strata not less than 3450 feet, which has disappeared.

Similarly, in the Lower Carboniferous under discussion, we have at Bridgeville a thickness of 2500 feet, which has been swept away. These great masses of matter have gone to form the millstone grit, the Coal measures, the Upper Coal measures, and perchance have swelled the volume of that new continent which the sounding lead has discovered beneath the waves of the Atlantic.

At first sight it may seem almost incredible that such enormous masses could be swept away by the agencies we now see in action around us; but from the surveys of Prof. Lesley, in Huntington and Centre Counties, Pennsylvania, it appears that Lower Silurian measures, formerly towering to a height of 30 or 40 thousand feet above the present sea level, are now but 2000 feet above it, and that they have yielded to denuding forces thousands of cubic miles of material which compose the cretaceous and tertiary deposits of New Jersey and Delaware.

We have now reached a point of importance, with regard to the origin of the Limonite ores, when we imagine that this great mass of Lower Carboniferous sediments, containing ferruginous shales and Limestones, formerly spread over a great part of the ground which now presents to our gaze strata of Silurian age.

Everywhere in the Carboniferous, at a distance varying from

50 to 500 yards from the Silurian slates, runs a bed or series of beds of Gypsum. This is prominently exposed at Glengarry, West Branch, Springville, McLellan's and Irish Mountains, and Sutherland's River. Between the Silurian and the Gypsum are numerous beds of Limestone, the thickest continuous one that I have seen being about 135 feet. The total thickness must be very much greater, as the section of denudation already referred to, at Bridgeville, appears to hold an almost unbroken series of Limestone beds.

The points of contact of these Limestones with the older slates afford many instructive sections bearing directly on the subject matter of this paper. One of them is as follows:—A bed of ferruginous Limestone rests on the Silurian slates, having at the point of contact a breccia of clay slate, cemented by a Calcareous paste. The fragments of slate are very close together in the immediate vicinity of the slates, but become more and more scattered until they disappear. Other beds of Limestone, shale and Gypsum complete the section.

In another section the ferruginous Limestone is replaced by a dark Carbonaceous one holding many fossils, followed by 100 feet of ordinary gray Limestone.

In another the pebbles appear rounded and the change to Limestone is quite abrupt. These Limestones are worn into caves and sink holes, frequently large enough to engulf good sized brooks for a portion of their course.

There is also another point to be considered in connection with this set of Limestones. Near Sutherland's River, in the same Lower Carboniferous horizon, is exposed a bed of Spathic ore, associated with Limestones and Gypsum, and only a few yards distant from the Silurian rocks. Fragments of Spathic ore occur in French River, one mile to the east. And on Sutherland's River, McLellan's Mountain and Brook, East and West Rivers, fragments of Spathic ore are also found in connection with this set of Limestones and Gypsums; and at one point on the East River there is exposed asemi-spathose Limestone holding 24.1 p. c. of Carbonate of Iron. Eight analyses of the Limestones of this district, made by myself, gave on an average 3 p. c. of this mineral.

We are, perhaps, not fully informed in the processes involved in the formation of the beds of Spathic ore. The Iron may be conjectured to have been deposited during the growth of the Limestones, and as a ferrous salt, to have been Carbonated by means of the decomposing organic matter which must have been present at that time.

If now we imagine this great mass of ferruginous sediments formerly overlapping, more or less, the present exposures of Silurian slates of the district, we have a compound admirably calculated for the formation of the Limonite ores of the East River as they are now presented to our view.

The precise manner in which this Limonite was separated, either from the Limestone, in which it formed a Carbonate, or from the shales which held it, probably as an *Anhydrous* sesquioxide, and re-deposited, is perhaps not fully understood.

Were the old outlines of the district restored, we would almost undoubtedly find the Pictou Coal field extending over this portion of it. The Carbonic acid dissolved in its waters from the decomposition of the vast masses of vegetable matter collected for the formation of our Coal seams, would furnish a most powerful agent which, charged with Iron as Carbonate, would penetrate the underlying measures whenever access was allowed through faults, etc.

We need not, however, draw upon this source. The ordinary per-centages of Carbonic acid present in the waters of our globe are amply sufficient for the changes we are contemplating, when we consider the time allowed for its action.

The water, charged with Carbonic acid, would take up the Iron in the strata as Bicarbonate, and filtering downward through the faults and meridional planes of the measures, would part with a portion of its Carbonic acid when it met the Limestone, and then, depositing its insoluble Carbonate of Iron, would take up Limestone and pass away as Bicarbonate of Lime.

Some of the Bicarbonate of Iron would also be decomposed in the cavities and fissures of the strata, with loss of Carbonic acid, and the resulting insoluble Iron salt would be deposited. The Carbonates of Iron thus thrown down as a distinct deposit,

and as a substitute for the Limestone, would be gradually oxydised and hydrated, as the air and water obtained access to it; and the same action would also change the beds of Spathic ore.

The action being continuous, and extending over a long interval of time, the deposits would gradually assume proportions of economic importance, in spite of the large quantities which would be removed by the various physical changes the district has undergone. In places which were not so much broken by faults, or where the strata were more compact, the Spathic ore would escape the oxydising process and remain to the present day as the Carbonate.

Gradually, as the erosion went on, these deposits would keep forming, and be more or less swept away. A large quantity of the ore would naturally rest on the comparatively dense Silurian slates and the edges of the Lower Carboniferous strata. Other bodies would become consolidated in the hollows formed in the Limestones. The beds of Spathose ore would become oxydised more or less generally, and the lines of fracture in the Silurian slates would also become receptacles for the ore.

Although as yet nothing beyond exploratory work has been done at these deposits, the sections attainable furnish instances of all the above effects, which we would theoretically expect. The oxydation of the Spathic deposits is shown by a section forming the counterpart of the one already referred to.

In this section we find a gore of argillaceous ochre or clay resting on the Silurian slates and replacing the breccia, and the Limonite replacing the ferruginous Limestone.

In another exploration a deposit of the Limonite was met under peculiar circumstances, which at first appeared to be discordant with the preceding sections and theories. It was, apparently, a bed in the Silurian clay slates, but this idea could not long be enteitained, as it was in a perpendicular position, while the neighboring slates had a uniform dip of about 50° and cut it obliquely in their strike. The deposit pursued a course parallel to that of the valley, and the enclosing slates were much fissured and filled with veins of Limonite and Calcspar.

It appeared to me that this was a fault which had perhaps for-

merly passed up into the Carboniferous Limestones which, as I have already shown, once covered this locality. In it the waters, charged with iron, would readily deposit their burden, now presented in the form of a cellular fibrous ore, very free from any mixture of clay, etc.

These deposits extend over a considerable extent of country, the width of the ore ground being in places 800 yards, but as yet they have been tested only near the points of contact of the two systems, which is owing to the facility thereby given for detecting them without much preliminary work.

At Whitehaven and Furness, and the Mendip Hills, in England, the Lower Carboniferous or Marine Limestones, are found occupying positions precisely similar to those described above, and their sections will answer for those we are now considering. In these Limestones are immense deposits of ore, which are supposed to have been formed in the same way. They are largely mined and furnish an important supply of pure ore.

At several places in Pennsylvania the Lower Silurian Calciferous formation holds large deposits of Limonite. These ores are, by some, considered to have been deposited in a similar manner. The Limonites of Artzberg and the Thuringian Forest are believed to have been formed in the same way.

I have now detained you long enough with these dry details, but before closing, would briefly lay before you the important deductions which may justly be drawn from the facts I have been able to collect.

This is, that there probably exists in the Lower Carboniferous Limestones of this country important and extended deposits of Spathic ore, and that a proper and systematic search will probably show valuable deposits of Limonite in connection with them in other localities besides the East River Valley.

The Spathic ores are highly prized by Iron makers, and are very valuable as a flux when the per-centage of Carbonate of Iron present is too low for them to rank as ores.

The search is impeded by the perishable nature of both Limonite and Spathic ore, and by the heavy covering of soil which is met everywhere on the strata of this age.

This, however, would not prove a serious impediment were any demand to arise for iron ores: at present there is so little inducement held out, that there has been hardly any search made for them in this Province.

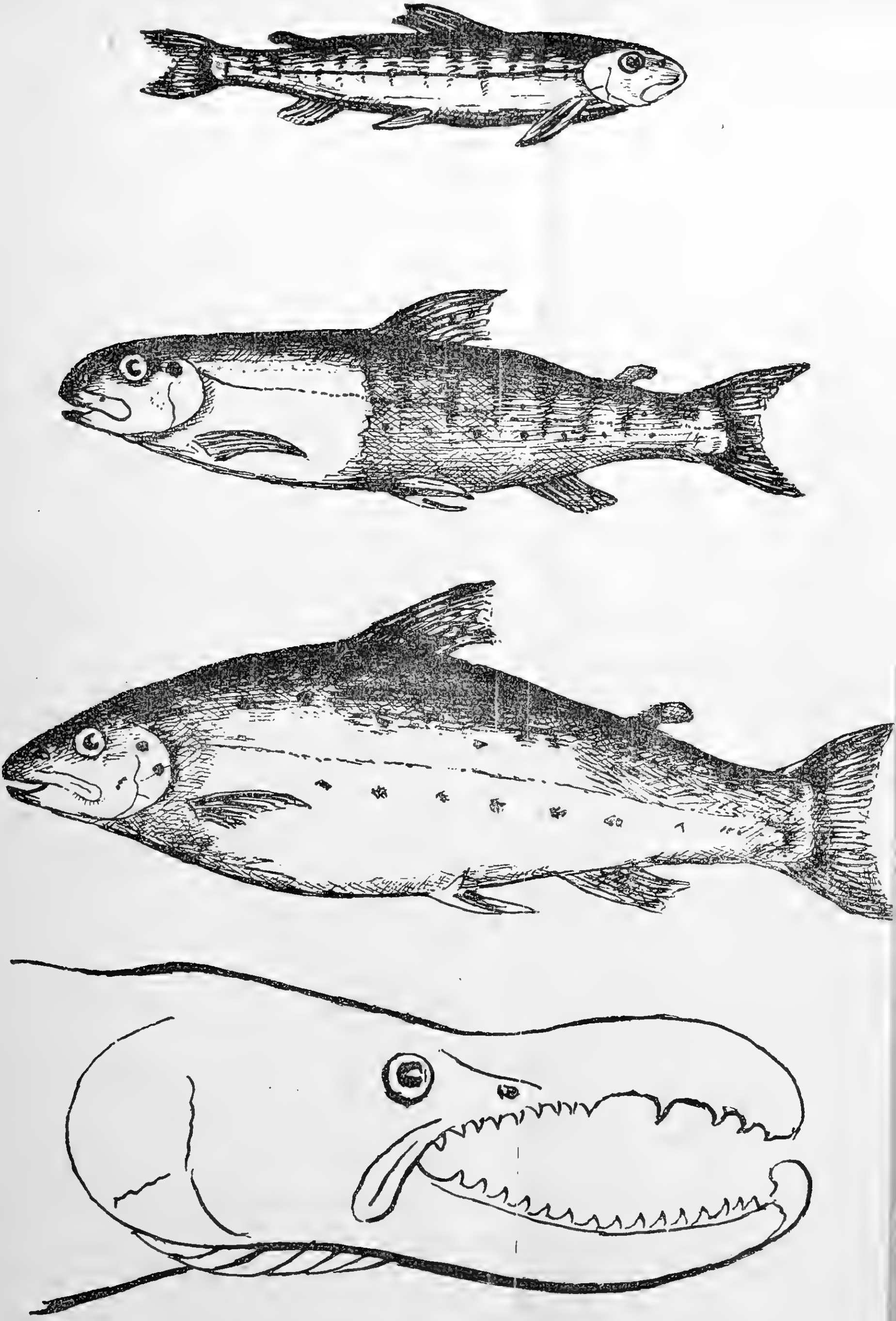
ART. VII.—ON THE SALMON OF NOVA SCOTIA.—BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(*Read February* 10, 1879.)

IT is more than ten years since I read a paper before the Institute on the Salmonide of Nova Scotia. Since that time I have had greater opportunities of studying their habits, and my opinions are somewhat modified as regards the new facts I have obtained. Although this paper will be almost a repetition of what has been told, yet I have thought the importance of the subject may well allow it to be re-told—to be verified by personal observation, and to be put in proper order, and to be shown how this order is modified by the natural features of this Province. Thus this paper will be not upon the Salmon in general, but upon the Salmon of Nova Scotia.

If we examine the map of this Province we will find it a narrow peninsula scarce seventy miles wide, whose interior is filled by numerous lake basins of about four hundred feet elevation, from which flow the various salmon river streams to the ocean. Thus our Salmon in seeking their spawning grounds have only an elevation of four hundred feet to overcome, and at farthest scarce thirty miles to ascend. We know further, from personal observation, that they rarely ascend so high, or so far, but are often seen spawning four or five miles from the tide, and scarce fifty feet elevation. This fact is so important with me in modifying their habits that I shall verify it presently by formal statements and dates. We also recollect our climate is cold, and that our lakes are frozen towards the end of November, attaining a thickness of nearly four feet of ice, which is broken up and descends the streams by the middle of April. This is the general average, though varying in different seasons. Now compare these facts with the genial lakes of Eng-

Gilpin. Nov. Scot. Salmon.



See description on other side.

Proc. Nov. Scot. Inst. V. p. 38.

1st.—A Pink, or Salmon six months old.

2nd.—A portrait of a Smolt half size. Taken 9th May, 1878, Digby, N. S., in a weir. In trying to escape he scaled himself, thus showing half Smolt, half Parr.

3rd.—A portrait of a ten pound Salmon in highest condition. Halifax Fish Market.

4th.—Head and jaws of a spawning male taken September, Shubenacadie River, and given me by M. Brown, Esq., Halifax.

land, seldom frozen on the toilsome passage to and from the sea, as some believe that the Lake Ontario fish have to perform. We must immediately admit that however valuable all these facts and personal observations may be, they can only be called the natural history of the Salmon of Nova Scotia.

Should any one diligently examine the shallow bottoms of our inland lakes or small streams, nay even the overflooded cart-ruts of an old road, he will find them filled with small fish or fry. On examining them they will be found of various sizes, but all differing from other minnows, by lateral bars upon their sides, and by having a rayless fin on the back near the tail. Some of these may be young trout, others young salmon. It is very hard to determine betwixt them. The sketches I show you came from Cole Harbour. Mr. Webb, Druggist, Water Street, had many of them in a vase in his window. They died very fast, and when he had them replenished, he was kind enough to procure me some, on Sept. 15, 1865. The eye is very large and the nose blunt, colour greenish with dusky bars and reddish fins. I have, myself, at Annapolis, seen the children catching them in brooks within a few yards of the tide, during October. These may be considered as having been hatched during April and May, and thus nearly five months old. They can not yet be called Parr, but rather Pinks. From that time I have been endeavoring through myself and my friends to obtain a Nova Scotia Parr; but have never succeeded. As these were taken late in September it is probable that the increasing frosts of October and November compel them to leave their shallow haunts and retreat to the lakes, which are soon frozen over, and thus they pass into Parrs unnoticed during early winter. Mr. Atkins, Commissioner of Fisheries, State of Maine, wrote me upon the same subject, saying he could never obtain Parrs.

By the first of May the Smolts become frequent in our lake waters, that is to say, these Parrs have now, in the early Spring, the lakes still ice-bound, cast off their greenish yellow with dusky bars, and present themselves in silver laced with blue, but still retaining the vermillion spots. Mr. Silver gave me one taken three miles from the sea, on May 1st, 1864, still retaining red spots. On

20th May, 1865, the one from which the sketch was made, I show you, was taken at Bedford, in my own presence, and within a few yards of tide. On 1st of June, 1864, Mr. Morrow gave me a Smolt taken six miles from the sea, but having no red spots. These dates are sufficient to show that in his Smolt form the Salmon is numerous now in our streams.

On 10th May, 1878, my son took a Smolt from a river in Digby Basin. He had travelled ten miles in the tide waters, and the nearest lake he might have been spawned in, may have been five or six miles from tide. In his efforts to free himself from the weir, he had scaled himself, and thus was one-half a smolt, the other half a parr.

Extreme length $7\frac{1}{2}$ inches, head contained four and half times in body, from nose to end of caudal fin. The opercle had the round edge peculiar to Salmon, and the fin end of maxilla—the round point—one opercular spot, nose a little blunt. There were teeth upon intermaxilla, maxillæ, and palatines, none on vomer. The silvery scales remained upon fore part of body. On the rest of the body where the scales had been rubbed away, the lateral bars of its Parr state were very apparent. There were six, I judged the silver scales covered three more. The sketch I show you is from my sketch book, and though it is only a repetition of Sir Humphrey Davy's beautiful drawing in the Salmonia, done many years ago, yet it was a satisfaction to have it, and to fix it by a date and a drawing as occurring in Nova Scotia.

These Smolts are all taken going seaward, and during spring and early summer, and well known to the young fishermen who take them by bait and in greater numbers than they should be allowed to do. During the latter part of August and September formerly, our markets were supplied from the Shubenacadie by small Salmon weighing two or three pounds called Grilse. Of late years, owing I suppose to the fishing act being carried out more strictly, I scarcely see them.

Mr. A. B. Wilmot, in his report dated 31st Dec., 1877, speaking of Bedford River, writes:—"I placed a small trap at the head of the first ladder over the dam immediately above the hatching house, and succeeded in capturing about sixty, mostly Grilse. They were taken about the latter part of September." Mr. Wilmot was obtaining Salmon for spawning purposes. Thus we find that young Salmon ascend our rivers during the fall, and not for spawning purposes. The Commissioner of Maine

Fisheries wrote me to explain why he had never captured Grilse in Maine, whilst we took them in the Shubenacadie. I could only refer him to Couche's British Fishes. No Grilse are taken in the Severn, but many in the Scotch rivers. The real reason is, I fancy, that though they ascend all rivers, yet some physical difference in each river makes it more or less a place of better observation. Thanks to the marking of Smolts in the breeding stations, we have long been enabled to connect the Smolt of a few ounces and about six inches long running to sea in May, with the Grilse weighing three or four pounds, and a foot and a half long running to fresh water in September. The enormous growth during that period is remarkable.

The next stage in the Salmon life to which I will point your attention, will be as he appears during spring and summer in the Halifax market. The first sea-run fish is usually taken about Yarmouth or Mahone Bay, in March. I have heard of one in February; indeed an Indian told me whilst fishing for trout through the ice in a mill-pond a mile from tide-way, he caught an ocean-run Salmon of ten pounds on New Year's day. He assured me it was an ocean fish, and indeed the fact of its taking bait would almost prove it. The Indian Saul took ocean-run Salmon by fly in January, Shelburne River, according to the Editor of *Forest and Stream*, New York, in a letter to me. During April, May and June they continue to run, and our markets are well supplied until July. As I wish this paper to be complete I will repeat from my paper of 1866, the description:

"The description of a fresh run of fish from the ocean as they appear in Spring, from our markets, would be: Weight from six pounds up to twenty. Head very small, body very deep, and at the same time round or thick through, back very muscular and tail strongly based. The opercle is circular on its outside edge. The free end of the upper maxilla also rounded. In both these parts they differ from trouts, the eye rather small and about two and one-half diameters from tip of nose, the nostril double. The outline of back round up from the head then runs gradually upwards to dorsal fin, the dorsal is irregularly rhomboidal. The adipose fin commences opposite the fifth ray of the anal, its posterior edge opposite its last ray. The tail is very strong, and the outline of back runs from dorsal to tail, descending in an equal curve with the rise anterior to dorsal. The belly runs in an outline similar to the back. The colour is black along the back running into steel blue with green reflections to lateral line, all below is silvery. The head and opercle are on the upper part dark blue, on the lower

silvery. On the opercle and pre-opercle one or two black spots. The colour of the fins are—dorsal lavender with irregular black spots, rays dark blue, adipose dark blue, caudal base and edges dark, the rest pale yellowish white, anal pale yellow, ventral yellowish, rays and anterior edge dark, pectoral pale bluish white, anterior edge and rays dark blue, a number of dark irregular blotches occur along sides and belly. Teeth upon intermaxilla, maxillæ, palatine bones, one to three upon vomer, and about nine or ten upon tongue.

"Rays P 11, A 9, C 20, V 9, D 12, Gill rays 11 each side a large axiliary scale to V.

"In counting fin rays I may state this as only an approximation, that the dorsal and anal may be said to have strictly proper webs, that in the dorsal the first ray is short and joined to second without webb, that the anal has also the first very thick, and that in the rest the rays starting as in the caudal from many irregular bases, and in the pectoral and ventral from one, the web being all but obliterated, it makes a count exceedingly difficult and varied by each counter. At the same time these rays vary in different specimens even in the dorsal, and are not typical."

I have presented you now with a description and portrait of a Nova Scotia Salmon in the full glow, strength and beauty of his magnificent proportions. His rounded back and powerful tail, the glorious steel blue of his back and sides, the opal lights ever reflecting on his silvery belly, tinged as it sometimes is with the warm pink of his blood-red flesh showing through, and the fair lavender of his fins cannot be described, must be seen to be realized. Formerly, after the season was over, Salmon were often brought to Halifax from the Shubenacadie river, during the middle of July. They were always out of season fish, blackish, with reddish blotches over them. On the 10th July, 1865, I purchased from about two dozen, the fish I now show you the sketch of. They all resembled each other. Both jaws were curved, the teeth were gone, the tongue exposed, and they were all out of season. On 26th November, 1865, Michael Brown Esq., sent me a Salmon, a male, weighing perhaps sixteen pounds, a sketch of which I now offer you. The intermaxilla articulation was very loose, and much enlarged, the intermaxilla bone itself had grown at least two inches in length, formed into a beak like an eagle's, and filled with large teeth. The lower jaw had also grown to correspond in length, and was also armed with large teeth, a cartilaginous knob projected upwards from the tip, which fitted into a groove above in the intermaxilla. The new jaws

were so arched, that it was impossible for them to close in the centre, and the teeth were much larger and with wider bases than usual. Mr. Stayner also gave me on March 14th, 1866, the head of a male much like the last, but with the appearance of a large ulcer upon the pre-opercle, as if the increased growth was now dropping off. From these facts we gather that our Salmon, at least some of them, enter the rivers in early spring, remain there, and as early as the middle of August, commence those changes in colour, and in the male of the jaws, which culminate in November. During November, the spawning season takes place.

Mr. A. B. Wilmot, Bedford, allows me personally to state these facts from him. That he has retained Salmon all winter in ponds of fresh water. That the jaws of the male commence their changes in September and finish in November, and after that seeming only to shrink till dismissed in spring. That he has never seen the immense jaws I have figured from a portrait taken from Shubenacadie. That he has seen the upper jaws entirely perforated by a large hole made by a knob from the lower, but has never known the lower jaw to drop off before the upper, as some have asserted. That they take no food during winter, and that he has known Salmon retaining the bright and silver scale all winter, in the midst of others entirely blackish and reddish, but this formed rather the exception than the rule. He thinks the body of Salmon in Nova Scotia winter in the lakes, the Parrs which he has opened having melts developed and not ovas, leads him to suppose the male parr matures sooner than the female. This corroborates Mr. Anderson's letter, and also agrees with the English Salmon. The Parrs run to sea late in the fall as well as in the spring. In the manipulations of fish, he finds those taken in November, and from the sea, much easier to manage, from the absence of nacre or slime which soon covers those in fresh water.

It is necessary for the preservation of the eggs that they be deposited on a gravelly bottom of a running brook. In the Province these spawning grounds occur often within three or four miles of the tide, and at an elevation of scarce sixty feet. My friend, W. C. Silver, Esq., allows me to say he has frequently

seen them spawning in Salmon River, three or four miles from tide, and about five miles from Halifax. Here the male, conspicuous by his hooked jaw, and the female with the spawn streaming from her, were seen furrowing up the gravel in water so shallow that their tails flapped out of water. Charles Anderson, Esq., Magistrate, informs me he has seen the same at the Musquodoboit River, and that the male makes furious rushes at other males approaching him, and that he is often surrounded by young males, scarcely seven inches long, but with hooked bills like the adults. This is corroborated by melt being found in Smolts before going to the sea, and also by the accounts of Salmon in English waters. Mr. John Duncan, Ingraham River, St. Margaret's Bay, told me he once saw Snake Lake filled by hundreds of spawning fish. This lake is one of the sources of Ingraham River, and can be but only a few miles from, or a few feet elevation above tide. Mr. James V. Buskirk saw during November, at least seventy Salmon spawning in pairs, in a shallow gravelly run from the Shubenacadie lakes, their tails lashed the surface, the stream was turbid by the white melt of the male which he emitted from above the female and shed upon the ova. Both sexes covered the ova with gravel, and attending trout were eating what the stream washed away. His dog rushed into the water, when they all disappeared, but returned immediately. This was about 14 miles from, and two hundred feet elevation above tide.

The spawn now shed and impregnated by the males, must soon be ice-covered, and remains till about the last of April, when the young fish escapes, but with a placenta attached to its body. From Mr. A. B. Wilmot's excellent report, we learn the various stages of artificial hatching. The black dot, the signs of life in the embryo, the escape from the egg, and the final discharge of the young fish to its native waters. I have already said that in March, (rarely in January and February,) the Salmon commence to run from the ocean up our rivers, and that this run continues till July, when the markets are closed. In Mr. John Mowat's report (Government Report, 1877) we find him taking Salmon for hatching purposes in the Metapedia, 24th August;

and again Mr. Wilmot in the Musquodoboit and Bedford, taking them in September and October, males more numerous than females, and many grilse. In the year 1865, the Sackville River was very low from the November droughts, and as many as thirty Salmon were seen at flat rock, unable to get up. Then we have records of fish going up from every month except December, and we must suppose that for various reasons, all the Salmon bred in our waters, are, during November, held in our lakes; with the exception of the Smolts going to sea, we have no record of Salmon returning to the ocean. I say record, for no one seems to have studied our rivers, and it was the common belief, even amongst naturalists, that after spawning they returned immediately to the sea, principally because they came from the sea in spring.

Some ten years ago the Rev. Mr. Williams, stationed at Truro, who brought his fondness for fishing from his native Wales, brought to my notice some fish which he caught in the Shubenacadie River, in April. They were descending beneath the loose ice in such numbers, and so ravenous, that he took two at a cast, and might have filled a boat in a few hours. They were true Salmon, but perfectly discoloured, reddish-black, spotted, and no silvery scale. On further enquiries, I found that the Musquodoboit River was subject to the same exodus, Mr. C. Anderson being my informant, and also those streams flowing from the Hants, Horton, and Cornwallis Basins, into the Bay of Fundy, through the Avon, were all thus crowded during early spring. Every spring we hear, especially from the eastern parts of the Province, of the wanton destruction of this fish, of their quantities, and the easiness of their capture. As we have no other record of their descending, we must conclude that as regards our own Province, the Salmon ascend our rivers from March to November, some remaining all summer, or perhaps returning to re-ascend again; though of this we have no proof, that they remain all winter and return in vast multitudes to the ocean in early spring. That our facts are scanty, must be allowed, the ice covering concealing our researches, and that they may not be true as regards other countries, is equally conceded, but until further investigation, I think they must be admitted.

I have now shown you our Salmon from his almost first appearance as a minnow, explained how in our rivers his changes into a Parr and Smolt are obscured by the ice; exhibited him going to sea for the first time as a Smolt, and also by a rare chance shown him to you in his form of half parr, and half smolt, and that produced by his own efforts. I have pointed him out as a grilse, shown him again in his grand proportions, and glorious flashings of silver light, as he is exposed in our markets, and have lastly given you some drawing of his degeneration in colour, of his leanness, and the singular and almost grotesque changes in the jaws of the male during spawning. In this I have given you nothing new, but only, as it were, given you old things, stated from original and new material, yet it is well to fix all these with a sketch and a date. In fixing the dates of his prolonged journey up river from the sea, and his rapid exodus downwards, I cannot deny that they still require confirmation. That they may be found to vary not only in the different rivers of the Province, but at different seasons in each river, why some ascend early, remain long in fresh water, and perform the function of spawning thoroughly degenerated, and others perform the same functions with all the strength and health of ocean run fish—(we find, Report Fisheries, 1877, that at one hatching station, the fish taken for spawning purposes were kept till wanted in tide way basins)—remains to be explained. If we compare our short streams with the St. Lawrence, or even the St. John, of New Brunswick, our shallow lakes, lying so close to sea-board, with Ontario, or even our ice-bound streams with the never frozen waters of England, or the arctic winters of Greenland and Labrador, and remember that the same species frequent all, we can only wonder that these vast physical differences have produced so little changes. In regard to the only new fact I have put before you, the retention of all the Salmon in our waters during the winter, in the inland lakes, I think I am justified in asserting it, or at least of drawing the attention of observers to it; but such observation should only be made where the physical features correspond with our own. If I have succeeded in giving you the itinerary of a Nova Scotian Salmon, with his biography attached, only approximately even, the object of this paper is effected.

We find also, principally from the Fishery Reports, the following facts:—That Salmon are more vigorous, and their ova equally fertile, that have never been in fresh water, but have been kept in tide-way reserve ponds. (Reports of Tadousac Breeding Establishment). That the Ontario Salmon on the contrary never go to salt water, but are equally vigorous, (see Mr. R. Wilmot's reports,) and that a few in Nova Scotia resist the fresh water changes. These facts are all comparatively new, and bearing as they do, so strongly upon the question of what are called land-locked Salmon, by many scientific men, still in the United States Fishery Commission, they are well worthy of a most minute, exact and scientific series of new observations, which might be made with little expense, if connected with the various fish breeding establishments of the Dominion. The growth of scale, the discolouration of flesh and of body, the changes of teeth and jaws in the male, and the peculiar changes in the pyloric cœca in fresh water and ocean fish (lately pointed out by R. Morrow, a member of our Institute) as taking place in the three forms of all fresh water, all salt water, and partly fresh and salt water, with exact dates and minute comparisons, would well reward the attempt, and be a small boon from the Government to her men of science.

ART. VIII.—ON THE ANKERITE VEINS OF LONDONDERRY, NOVA SCOTIA.—BY HENRY LOUIS, *Assoc. R. Society, Mines, London.*

(*Read March 10th*, 1879.)

EXTENDING along the base of the southern slope of the Cobequid mountains, and parallel, roughly speaking, to the mountain axis, is a remarkable series of fissure veins, filled with a number of interesting minerals, of which, as at present known, the most plentiful and the most characteristic is the Ankerite. These veins, which I shall in this paper designate the Ankerite veins, although Ankerite is not by any means their sole constituent, occur in a band of slate and shale, varying in colour from a dark blue to a pale olive green, and forming apparently the topmost

beds of the Silurian formation. They are found of all thicknesses from about the tenth of an inch up to fifty feet; the larger deposits are very variable in thickness, much faulted, and approximately parallel to each other and to the general strike of the strata, whilst the rocks between them are frequently traversed in every direction by a network of the smaller veins. These veinlets appear to occur for the most part in the blue slates, but the walls of the larger deposits most frequently consist of greenish-grey shale. I have not been able to make out any definite relations between the modes of occurrence of these two classes of Ankerite veins.

Wherever I have been able to examine these deposits, I have found them to present very similar characters. Most of my observations have been made on the large deposits of Ankerite in the right bank of the west branch of Great Village river, which has been very extensively quarried: I have, however, no doubt but that they will apply equally well to any portion of the series of Ankerite veins.

The following descriptive list includes all the minerals that I have up to the present met with in these veins:—

1st.—Ankerite. This mineral occurs most frequently in the massive crystalline state, readily cleavable into rhombohedra, the cleavage planes being often very large; sometimes, but more rarely, it is cryptocrystalline and granular. I have, however, also found it in true crystals, lining the walls of a small fissure in the vein. The crystalline form is the simple primary rhombohedron, very minute, the largest crystal not being over $\frac{1}{8}$ inch in length, and the faces too dull for measurement. The colour of Ankerite before it has been exposed to the atmosphere is pure white, but, owing to the rapidity with which its protoxide of iron is per-oxidized, it is usually found of a yellow or brownish colour.

Its specific gravity is 2.998.

The following are analyses of three specimens of the pure mineral; Nos. I and II were white, and No. III of a brownish tinge:—

	I.	II.	III.
Insoluble Siliceous Matter	0.57	0.12	0.19
Calcic Carbonate...............	53.64	49.32	54.96
Ferrous "	23.29	23.11	21.92
Manganous "	0.77	0.68	1.29
Magnesic "	21.48	26.29	21.42
Ferric Oxide..................	trace.		1.05
	99.75	99.52	100.83

By taking the mean of these and numerous other analyses, I deduce the following for the average composition of Ankerite, disregarding the insoluble matter:—

Calcic Carbonate	53.75	
Ferrous "	22.70	23.50
Manganous "	0.80	
Magnesic "	22.75	
	100.00	

This would demand for Ankerite the formula 8 Ca Co_3 + 3 Fe Co_3 + 4 Mg Co_3; a small proportion of the Iron being replaced by Manganese. The composition corresponding to this formula is:—

Calcic Carbonate	53.90
Ferrous "	23.45
Magnesic "	22.65
	100.00

The correspondence of this composition with that actually found is sufficiently close to warrant the above formula for Ankerite. It must, however, be borne in mind that all the Carbonates composing Ankerite are isomorphous, and therefore capable of replacing each other in any proportions; this circumstance of course precludes the possibility of obtaining any universally applicable formula for Ankerite. As an example of the irregularities produced by isomorphism, I may instance the following

analysis of a specimen of white cryptocrystalline Ankerite, which contains much more Lime, and also less Magnesia in proportion to the Iron than the normal mineral:—

Insoluble Matter	0.53
Calcic Carbonate	71.23
Ferrous "	16.41
Manganous "	2.65
Magnesic "	9.34
	100.16

The formula for this structure is 13 $Ca\ Co_3 + 3\ Fe\ Co_3 + 2\ Mg\ Co_3$. It appeared to be perfectly homogeneous in structure, and may possibly be Ankerite altered by the action of water carrying Calcic Carbonate in solution.

2nd.—Sideroplesite.—(Classed by Dana as a variety of Siderite)—This mineral occurs in the Ankerite quarry in small veinlets penetrating the mass of the Ankerite, but appears to become more abundant in the deeper lying parts of the deposits; thus, in the upper levels of the West Mines, Sideroplesite and Ankerite are found in irregularly interlacing veins and masses, in about equal proportions, as will be shown by an analysis to be given below, while in the lower levels of the same mine very large deposits occur, containing only here and there small veinlets and patches of Ankerite; so extensive indeed are these deposits, that if they hold in depth, as they now promise to, they will become of high economic importance. I have never seen any crystals of Sideroplesite, but it is always highly crystalline, although the cleavage planes are smaller than in Ankerite, and, instead of being continuous through large masses, are inclined in all directions, so that a fractured surface shows a number of small and irregularly divergent cleavages. Its colour is pearl grey, but on exposure to the air it oxidises with great rapidity, assuming a brownish tinge.

Its specific gravity is 3.523.

The following are analyses of some characteristic specimens:—

	I.	II.	III.
Insoluble Siliceous Matter	0.43	0.47	0.25
Calcic Carbonate	1.03	0.59	3.14
Ferrous "	67.96	69.20	68.47
Manganous "	2.19	1.37	2.08
Magnesic "	27.87	28.73	26.02
Ferric Oxide		0.08	
	99.48	100.44	99.96

The average composition, exclusive of insoluble matter, as derived from several analyses, is:—

Calcic Carbonate	1.92
Ferrous "	68.15
Manganous "	1.87
Magnesic "	28.06
	100.00

Evidently, the Manganous and Calcic Carbonates are only accidentally present, the main constituents being:—

Ferrous Carbonate	70.02
Magnesic "	29.98
	100.00

The formula that most nearly corresponds to this composition is $5\ Fe\ Co_3 + 3\ Mg\ Co_3$. The per centage composition required by this formula is:—

Ferrous Carbonate	69.72
Magnesic "	30.28
	100.00

This may also be written for the sake of comparison:—

Carbonic Anhydride	42.30
Ferrous Oxide	43.28
Magnesia	14.42
	100.00

Breithaupt gives $2 FeCO_3 + MgCO_3$ as the formula for his Sideroplesite, and the following as its composition :—

Carbonic Anhydride	41.93
Ferrous Oxide	45.06
Magnesia	12.16
	99.15

Thus, the composition as well as the physical characters of our Nova Scotian minerals approach very nearly to those of Breithaupt's Sideroplesite, more nearly in fact than to those of any other mineral that I know of, and I think that there can be little doubt but that it should be referred to this variety. Having regard, however, to the very large quantities of this mineral lately discovered at Londonderry, to its well defined chemical composition and physical characters, I would venture to suggest that Sideroplesite is fully entitled to be classed as a well defined mineral species, rather than as a mere variety of Siderite.

The following is an analysis of a sample of mixed Ankerite and Sideroplesite, taken from a large deposit of mineral, in which both species were present, in one of the upper levels of the West Mines :—

Insoluble Matter	0.31
Calcic Carbonate	27.52
Ferrous "	46.09
Manganous "	2.28
Magnesic "	23.80
	100.00

This composition corresponds to the formula $2 CaCO_3 + 3 FeCO_3 + MgCO_3$; equal to a mixture of about five parts of Ankerite and six of Sideroplesite.

These two are by far the most abundant of the minerals occurring in these veins, the rest being present only in small quantities, and usually near the walls.

3rd.—Barytes.—This mineral occurs in fissures in the Ankerite veins, occasionally in small tabular crystals, but more often in

highly cleavable masses, sometimes white, usually pink or flesh-coloured.

4th.—Calcite.—This mineral is found lining fissures in the well known form of Dogtooth Spar, and in large, often drusy, scalenohedra. It is not, however, a pure Calcite, as is shown by the following analyses, the first being that of a specimen of Dogtooth Spar, and the second of a large scalenohedron :—

	I.	II.
Insoluble Matter	trace.	
Calcic Carbonate	95.93	90.69
Ferrous "	1.45	3.25
Manganous "	2.77	1.49
Magnesic "	0.57	4.06
	100.72	99.49

5th.—Aragonite.—It occurs in acicular crystals, lining fissures or cavities in the Ankerite, or implanted upon Barytes or Calcite. The crystals vary in size from an inch or more in length down to microscopic minuteness. Aragonite appears to have been one of the last minerals introduced into the vein, as it is invariably found investing the others.

6th.—Iron pyrites occur sparingly in very minute disseminated crystals, near the south or hanging wall.

7th.—Specular ore occurs in thin veins ramifying through the Ankerite, and in some places forms a layer about one inch in thickness between the Ankerite itself and the hanging wall. Veinlets of Specular Ore are also found penetrating into the shales on the same side.

This list comprises all the original mineral constituents, as at present known, but in addition to these we have in small quantities in the upper parts of the veins the decomposition products of Ankerite and Sideroplesite, which, from their intimate connection with the origin of the Londonderry Iron ores, acquire a high degree of interest. Whilst all these ores are probably derived from the decompositions of the Carbonates, the only one that shows in its actual structure any proof of such origin is that known as "Red ore."

This ore occurs in deposits having the same average direction as the Ankerite veins, (namely, from 5° to 10° N. of W.,) and it mostly runs out in descending into Ankerite or, more frequently, Sideroplesite. Rounded boulders of both of these minerals are not uncommon in the "Red ore."

Red ore is amorphous and earthy in fracture. It is often very distinctly pseudomorphous, after Ankerite or Sideroplesite, when the cleavage planes of the original mineral are very evident in the Red ore and are indicated by a strong satiny lustre. The hardness of the ore is between 2 and 3: its colour varies from deep red through all the shades of reddish-brown to pale brown, the red colour being by far the most common, and the clear brown comparatively rare. The following analyses will serve to indicate its general character. Analysis No. I was made on a deep red specimen, and No. II on a brown specimen of the ore, both showing distinctly the cleavage planes of the original mineral:—

	I.	II.
Insoluble Matter	2.71	3.73
Alumina	trace.	trace.
Ferric Oxide	87.21	83.21
Trimanganic Tetroxide	1.67	1.83
Lime	trace.	trace.
Magnesia	0.45	0.65
Combined Water	8.01	10.18
Phosphoric Acid	trace.	trace.
	100.05	99.60

It will be seen that the composition of these, like all the Londonderry ores, is approximately that of Gœthite, namely, Fe_2O_3 H_2O; they are, however, not only very different from the ordinary brown Hæmatites of this locality in appearance, but differ also in containing less siliceous matter and phosphoric acid. It is very difficult to assign these Red ores to any definite mineral species, the characteristics of the bright red variety being especially puzzling. While it differs from Turgite, in containing nearly twice as much water of hydration, and in not decrepitat-

ing when heated, its distinct red colour and streak separate it from all the other hydrates of Iron; and numerous and indefinite though they are, there is no species with which it can fairly be classed.

As regards the origin and formation of the Londonderry deposits, the following appears to be their history, as far as our present limited Geological knowledge of this region allows us to read it. The close of the Silurian epoch was brought about in this region by the elevation of the land now forming the Cobequid Mountains. This elevation was accompanied by extensive dislocation and fracture of the strata, and in this way a long series of clefts was produced in the region extending along the base of the Cobequids, this having evidently been the line of least resistance to fracture. These fissures were then filled with Ankerite and Sideroplesite, introduced, as I believe, in solution in water. It has been supposed by some that these minerals were introduced into the fissures in a state of fusion, or at any rate, under conditions of intense heat. I am not aware that the feasibility of fusing either of these minerals without decomposition has ever yet been demonstrated, but as Calcic Carbonate has been fused under pressure, it is possible that a similar result might be obtained with them. If then the plutonic hypothesis is the correct one, their formation must have been effected at a sufficient depth in the interior of the earth to produce the necessary pressure as well as heat; but it is by no means clear to me how, at so great a depth, where the surrounding strata must at least have been softened, such sharp and extensive fissures could have been produced. Moreover, the effect of this intense heat ought to be traceable in the walls of the veins. Some of the walls of the very narrow veins certainly consist of highly metamorphic slate, but I found that a sample taken from the walls of the large Ankerite vein at Acadia Mines was highly plastic when ground fine and mixed with water, and that it contained as much as 8.15 p.c. of combined water. These walls had surely not been exposed to a temperature above red heat, unless indeed rehydration in such a case were possible. Fragments of the walls with sharp edges, and apparently differing in no respect

from the wall itself, are occasionally found embedded in the Ankerite. The general appearance too of the vein, its wedge-like shape, narrowing downwards, and the mode in which the minerals are arranged in it, all appear to me to suggest its formation by aqueous agency.

As to the other minerals present, they are evidently of far later date than the vein itself, and have been formed by the action of water percolating through the fissures of the Ankerite. I may here mention as an instance of such action, that I have found near the Ankerite quarry conglomerates consisting of pebbles of Ankerite and other rocks united by a calcareous cement. In this connection too, it is interesting to note that whenever Aragonite and Calcite are present in the same fissure, the former invariably invests the latter, but never vice versa. The most generally accepted theory regarding these two minerals is, that Aragonite was deposited from hot water and Calcite from cold; this theory, if true, would lead us to infer that the Ankerite vein was exposed to the action first of cold, and at a later period, of heated waters.

When a mass of Ankerite or Sideroplesite is left exposed to the atmosphere for a number of years, a thin crust of brown or red hydrate of Iron forms upon its surface, the Calcic and Magnesic Carbonates being superficially carried off in solution. Here we have reproduced before our eyes the chemical phenomena to which we owe the Red ore. This ore has been produced by the joint action of air and moisture upon the Carbonates in the Ankerite vein. The air and Carbonic acid, dissolved in common water, would probably suffice for this reaction, which might perhaps be aided by a low degree of heat; but at a red heat, as I have ascertained by experiment, anhydrous Ferric oxide, (and not Ferric hydrate,) is produced, even when steam is passed over the heated mineral. So gradual has the decomposition of the original minerals been, that their shape and cleavage have been perfectly maintained during the course of the metamorphism.

As to the Brown Hæmatites forming the bulk of the Londonderry ores, their mode of formation is somewhat more obscure, but is probably as follows: At a period subsequent to the formation of

the Ankerite veins, perhaps at the close of the Carboniferous epoch, the strata then existing were again much dislocated and fractured in consequence of further upheaval of the land in the Cobequid region, as is shown by the excessive faulting and numerous slickensides in the Ankerite veins. A fresh series of fissures was formed in about the same line of weakness as before, but this time with an average direction of 10° S. of W. Carbonated and ærated waters, trickling through the Ankerite veins, dissolved the Carbonates of Iron, Lime and Magnesia, perhaps with the simultaneous production of Red ore in the upper portions of the veins. The dissolved bicarbonate of Iron was then in its turn decomposed, oxidised, and deposited in the form of a bog ore, together with some of the comminuted shales derived from the surrounding rocks, this being the source of the siliceous matter present in the Londonderry Brown Hæmatites. These ores have all the appearance of bog ore, and also resemble it in composition; at times, too, they show small boulders of shale and Ankerite, as would be expected from such a mode of origin. They are thus secondary products of decomposition and solution, while the Red ore is the product of the primary decomposition *in situ* of the original Carbonates.

The mode in which the Brown Hæmatites have been produced may be readily illustrated in the laboratory. In the course of some experiments on this subject, I found that when Ankerite finely ground was suspended in water, and a current of Carbonic anhydride passed through it for about 10 hours, 13.5 p.c. of the Ankerite was dissolved. On blowing air through the clear solution, the Iron present was deposited in the form of a yellowish brown hydrate. On repeating the experiment with Sideroplesite, I obtained similar results, but the current of Carbonic anhydride was only kept up for about six hours, dissolving 8.2 p.c. of the mineral.

In conclusion, I once more wish to remind you that the geological relations of these veins to the surrounding strata are yet very obscure, and that the sketch of their history which I have here attempted to produce, may at any time be liable to correction when an exhaustive geological survey of the district shall have been made.

ART. IX.—MAGNETISM, THE LIFE OF THE WORLD.—BY ANDREW DEWAR.

(*Read April 14th*, 1879.)

IN commencing I may say that I quarrel with no religious bodies or opinions. In saying that Magnetism is the *Life* of the World, I mean in its broadest sense and as a physical fact only.

By life, I mean the life force, or vital principle, which animates and regulates everything, from the crystals in the rocks to the spreading of the tree and the breathing of the animal. One law, (and is it not a grand and likely idea,) one law pervades the world, and regulates itself and everything connected with it as one body, even such a body as our own is. Thus, what we consider space, may be to the planets as firm and compact a material as our flesh is to our bones or blood veins.

Before we indicate the connection between life and magnetism, we must show first what magnetism is, according to our ideas of it, the properties it possesses, and the extent of its domain.

Magnetism was, and still is supposed to be a property belonging peculiarly to iron. Certain particles of iron were seen to attract and repel one another, and this force was called magnetism. We observe, however, that other materials attract and repel one another, although not in so marked a manner.

For instance, there are layers of slate, freestone, shale, coal, granite, etc., all separate and distinct, each material by itself. The question arises, how came each material to be so stratified? It could only be done in two ways. Either it was brought and placed there by physical means, through some superhuman agency; or, which is the more likely, the attraction of like materials, and the consequent repulsion of unlike materials, formed these beds, when, possibly, everything was in a state of solution.

All matter then, (and innumerable examples and facts will occur to every one to prove the assertion,) is governed by a law of the attraction of like materials.

But, as iron particles exhibit polarity, so we believe do the atoms of all other materials. Our reason is, that we find a con-

structive principle among all materials. This principle must be guided by some law. If then we can find a law which controls any of the earth's materials, and which in its action would explain the crystalization of others, we think we would be justified in accepting it, instead of searching out some entirely new law.

Such a law is that of Polarity, viz.: Every atom has two poles which, for the sake of illustration, may be called positive and negative. When at rest, as in a block of stone or metal, the positive pole of each atom has hold of the negative pole above it, and the negative pole a hold of the positive below it. It is this regularity which causes many materials to scale so easily.

In solution, similar poles of similar material repel and scatter one another, while opposite poles attract and accumulate.

The Law of Polarity, generally stated, is, that similar poles of similar material coming together in solution or in fire, repel, scatter, reduce, dissolve and destroy one another, while opposite poles in solution, attract, increase, reform and rebuild.

Every permanent production of the earth has been formed either in or by water, or by fire; and, generally speaking, every natural production has been formed by water, while every artificial one is by fire.

From these two laws, the attraction and repulsion of matter, and the law of polarity, we have deduced the law of Atomagnetism, which we have announced as the *law* governing the universe. In connection with this enunciation, it must be borne in mind that the law is not given to supplant another, but to fill a void in physical science which has never yet been filled. Going deeper than gravitation into the constitution and force of matter, it also absorbs it and widens itself to an indefinite extent beyond it.

The law of atomagnetism is as follows: The materials of the earth are all divided into two great classes, mineral and vegetable, or hydrogen and oxygen. Each class has innumerable distinct component parts, forming the different minerals or varieties of vegetation and animal life. By these two classes and their interaction or connection, according to the above given laws of Matter and Polarity, everything in the world is either formed and built up, or dissolved and destroyed.

Magnetism is thus the life of the law, and consequently, the life of matter.

We will give a few facts showing that matter has polarity. If water freezes gently on a pond, the ice is perfectly transparent; but if a wind blows while it is being congealed, the ice is whitish and opaque. In the former case the atoms were not disturbed, and thus they arranged themselves in perfect polar order. In the latter the poles were disturbed, and congealed in a disturbed state.

In making sugar-candy, if the material is gently poured out, the candy will be comparatively transparent; but if it is *pulled* before it hardens, it soon becomes opaque, and becomes whiter with every pulling. It is sometimes said that the air mixing the water or sugar produces the opacity; but why should air, a transparent substance, mixing with water, also a transparent body, produce opacity, unless there were some constitutional law such as we have stated to cause it. In crushing many transparent or semi-transparent bodies they become whiter. We believe that in these facts is to be found the solution of the phenomena of light and flame, and the mystery of the comet's tail. The greater the friction of disorganized poles among suitable material, the more brilliant the light.

In frost ferns on window panes we see another instance of the polarity of matter, and this time in distinct magnetic action. Just as filings placed on the end of a magnet arrange themselves in distinct lines or feelers, so do the particles of ice array themselves, and each frond starting from the same centre, repels every other frond. If two similar magnetic poles are brought together, with iron filings on each, the repulsion is so great that the filings drop off. We have observed a similar effect with the frost ferns, for the points of the two fronds on nearing one another were seen to be shattered by some invisible force into utter confusion.

These frost ferns may be said to be links between rock and plant life, and the little frost bush which grows on ice under peculiar circumstances of thaw and frost is another. The bushes, which are from a half inch to two inches high, are per-

fect samples of vegetation, with feathered branches shooting out on every side. The construction is by the same polar law. A rising piece of ice forms a pole, on which the drifting particles of snow or ice congeal and arrange themselves by the magnetic force from the pole.

The lead tree hung in solution is formed in a similar way, and it is our belief that coral is only a similar mineral growth, formed entirely independent of the coral insect, which we consider only a parasite of it. In fact, we think we would be quite as justified in saying that the aphis makes the rose bush, as that the coral insect makes the coral.

All matter then has life. It may be inert, as in a block of stone, but change its condition by crushing it and put it in a suitable solution and position, and it will give life to a lofty tree by the exercise of its inherent atomagnetic law. Thus far we have been dealing with what may be called mineral life.

PLANT LIFE.

In tracing the connection between plant life and magnetism, it must be borne in mind that there is no theory of plant life before the world. It is considered an enigma undiscoverable by man. In suggesting magnetism as the life of the plants, we at least are not irreverent in doing so, as magnetism is a law of nature; and, as we have said before, if magnetism guides and controls some materials, why should we look for another law, if its action can explain all the phenomena of plant life. Magnetism is the only force we know of which directly controls any class of matter, and as plant life as well as any other must necessarily be controlled by some law, it is surely our bounden duty to test the laws of magnetism first before we seek for any other; and in our opinion, there is no need to do so.

In examining all plants, we find them to have a trunk or stalk, roots, and branches. Holding a plant in our hands, and observing that the roots are dispersed from one end and the leaves from the other, we naturally say the force must be from the centre either way; that is, from the trunk or stalk. Is this according to magnetic law? Yes. Taking a magnetised bar of iron, and scattering filings over it, we find they adhere princi-

pally to the poles, and, as far as the material will allow them, they are there formed into roots and branches. Moreover, as each branch and root fibre follows an individual course and repels its neighbours, so do the roots and branches of the filings. Again, if two leaves on the same tree are forced to meet and touch one another, in a few days they begin to fade and wither, thus seeming to repel and kill one another; so, in a magnet, if we force the filings on similar poles to meet, they also drop off, and, as it were, fade.

A seed, again, is as much a magnet with two poles as the magnetised iron bar; and as the bar does not seem to be a magnet until the filings are scattered over it, so, neither does the seed until it is placed in a position to show its poles, viz., in the earth, where, with heat and moisture, its magnetic character is apparent, for a root and a leaf is at once thrown out, thus showing its indestructible polarity.

Besides being governed by its own inherent magnetism, a tree is also influenced by the magnetism of the earth. If a tree was left to its own magnetism it might grow in a slanting direction, and, especially on a hill side, a forest might become entangled in inextricable confusion. We find, however, a wonderful regularity in the growth of trees, and even on the steepest hills they never vary from the exact vertical. This is caused by the magnetic force of the earth, which is continually in action, and must necessarily be vertical.

Summing all the evidence together, the similarity between the action of a magnet and plant life is such that we see not how it can possibly be overlooked or set aside. Enough it is for us that finding plant life a mystery, we see no mystery in it when read by the light of magnetism, and our only desire is that botanists may test it for their own satisfaction.

ANIMAL LIFE.

To prove the connection between animal life and magnetism may seem more difficult than in the previous divisions of the subject, but it is not so in reality. It is well known that men and animals are possessed of magnetism. The teaching of the present day tends to separate material, from animal magnetism,

but the force is the same. It may exhibit itself in a hundred different ways, according to its condition, position, and materials under its influence. Sufficient attention is not often paid to the different conditions under which a force may either work easily or labour, according as they are favourable or the reverse.

A man can draw a spark of electricity from another man's nose, and some men after a brisk walk light the gas with their finger. We might, as a preliminary, argue that if a body is possessed of magnetism, that body must be a magnet, and if a magnet, then the certainty is that the principles of magnetism guide and control that body. But a man is not like either a mineral or vegetable magnet. He is a more compact body and in a—comparatively speaking—state of solution.

The great and essential difference, however, between a plant and an animal is, that the former is stationary and has its food supplied to it, while the latter is migratory and seeks its food. The former is, comparatively speaking, hard and solid, while the latter is pliable and soft. The former is connected with one huge feeding ground and galvanic battery, from which it draws supplies both of food and magnetic force, while the animal is cut off from this supply, and must consequently be endowed with an apparatus which will answer the same purpose, and which it can carry about with it. This apparatus is the stomach, the galvanic battery of the animal, where life is originated and sustained.

The Electric Telegraph supplies us with a grand illustration of the nature and working of this animal battery. In the battery of this apparatus we see two metals, zinc and copper, dissolving in diluted sulphuric acid, and the action produces a force possessed of enormous capabilities, which are only beginning to be known.

In the stomach of man, or other animal, a similar dissolving process is continually going on with the food put into it, and the force thereby developed causes and keeps up the circulation of the blood and the whole life action of the body, enabling it to move wherever it desires, and to perform all kinds of exercise and locomotion.

Nor does the resemblance end here, for there is a wonderful

similarity between the telegraph switch and the animal brain. From the battery only two wires, one from either pole, lead the force to the *switch*; yet from this switch any number of wires may radiate, each one endowed with equal magnetic force, or the whole may be concentrated in one. From our stomach two cords also lead up the spine to the base of the brain, (which may be compared to the telegraph switch,) and from the brain the whole nervous system of the human body proceeds.

The inference to be deduced from this wonderful coincidence is, that the body is merely a machine, whose brain is controlled by the magnetism of the body; the *mind* being the *telegraph operator*.

An animal is thus as much a magnet as a plant, and its life is magnetism.

In concluding our argument that magnetism is the life of the world, if we have proved that minerals, plants and animals all live and grow by magnetism, then it only remains to show that the earth is a magnet; but this is a well established and acknowledged fact, and thus it is only making more certain what is sure, by proving plants and animals magnets; for the invariable law of magnetism is, that every atom of a magnet, no matter how connected, is also a complete magnet as well as a part of the whole.

Art. X.—Nova Scotian Geology.—Notes to Retrospect of 1878.—By Rev. D. Honeyman, D. C. L., *Hon. Memb. Geol. Assoc., London, &c., Fellow of the University of Halifax, Curator of the Provincial Museum, Professor of Geology Dalhousie College and University.*

(*Read April 14th,* 1879.)

After I read my essay "On the Fossiliferous Rocks of Arisaig," before the Halifax Literary and Scientific Society, in April, 1859, a notice appeared in the *Presbyterian Witness* newspaper, in which the editor stated "that I had settled questions that had puzzled Lyell and Dawson," regarding the age of the Arisaig rocks.

The author of Acadian Geology, who is a reader of the *Witness*, and always on the *qui vive* in matters relating to the Geology of Nova Scotia, shortly after sent me a letter from Montreal, in which he expressed his gratification at my directing attention to the interesting rocks of Arisaig, observing that the rocks were "probably" of Lower Helderberg age. In a letter replying, I said that they were "certainly" of Upper Ludlow age, and that my reasons for regarding them to be of that age would be seen from the abstract of my paper, then in the press, when published.

I was not then the owner of a copy of Acadian Geology. I had only seen and read a copy of it in Pictou immediately after its publication. I distinctly remembered, however, that they were considered to be of Hamilton and Chemung age, U. S., Devonian.

In now regarding them as "probably Lower Helderberg, U. S.," the author had adopted the only alternative. I suspected that the opinion expressed was suggested by the observation in the *Presbyterian Witness*. This may be what the author calls "simultaneously and independently" in Acadian Geology, second edition.

I did not refer to the correspondence in my "Retrospect." I only referred to printed documents, not considering that the author was committed to the opinion, somewhat cautiously expressed, until it appeared in printed form. I have searched in vain to find any evidence of this kind until 1860. It is not to be found in the catalogue of "Acadian Geology."

On this ground I preferred the claim to having taken "the first steps onward."

Corrections.

I find that, trusting my memory, I was led into error in some *of the reasons* that I assigned as objections to the division of the Arisaig fossiliferous rocks into Upper and Lower by the author of "Acadian Geology." When I wrote the objection, I forgot that he made the division in his paper in the *Canadian Naturalist* in 1860.

At the time the division was made it seemed altogether pro-

per, while at the time of the publication of "Acadian Geology," 1868, it had become objectionable by reason of the further development of the series and Salter's determinations of the several members. My proper reasons were then given, when I had occasion to make a "Middle Arisaig series." *Vide* paper "on the I. C. R. in the Cobequids," pp. 390, 392, *Transactions of the Institute*, 1873-4.

I shall quote these: "After the lapse of ten years, and a great amount of labour and research, I consider that the alphabetical division is the only unobjectionable one that has been proposed, and that the only modification of the British division required is the omission of the 'Lower Ludlow,' which was not suggested by Mr. Salter. Previous to Mr. Salter's examination and correlation, I had correlated D with the Upper Ludlow of Wales. Dr. Dawson, at the same time, correlated C and D with the Lower Helderberg, U. S., and B' with the Clinton, U. S. D and C are further distinguished by Dr. Dawson 'Upper Arisaig,' and B' 'Lower Arisaig.' Extensive observation has proved that Mr. Salter was correct in giving the Arisaig series a greater range in time than that given by Dr. Dawson. I have referred to another division of the Arisaig series into Upper and Lower, the Lower Helderberg equivalent being the *Upper*, and the Clinton the Lower *Arisaig*. There are two applications of the word Arisaig. There is the *Arisaig township* and the *locality Arisaig*. In the former sense it is much too restricted, as it ignores a great part of the Arisaig series, besides a typical series of Crystalline rock, which I have elsewhere designated as 'Lower Arisaig,'—*Transactions*, 1872,—and Carboniferous rocks. In the latter sense it includes too much, as the 'Lower Arisaig' of the division *alone* lies in Arisaig, while the 'Upper Arisaig' is in the Moidart.

"On these grounds I consider these divisions as untenable."

Acadian Geology.

Maps.

In my remarks upon the Maps of the two editions of Acadian Geology, I did not make sufficient allowance for necessary imperfections, so that my remarks seem to be somewhat *hypercritical*; still, it cannot be denied that on some very important

points the map of the second edition is the reverse of an improvement on that of the first.

A New Map.

Much has been done by the Geological Survey and others in exact surveying and mapping in Nova Scotia and Cape Breton since 1868. The publication of a progress map on a larger scale than the maps of Acadian Geology, indicating the work thus accomplished, is certainly a great *desideratum.*

Maps Constructed since 1868.

Maps of Nova Scotia and Cape Breton, accompanying Reports of Geological Survey of Canada.

Robb & Fletcher's.

Prof. Hind's Maps, published by the N. S. Department of Mines.

The Author's Maps in the Museum portfolio, constructed to illustrate papers on Nova Scotian Geology read before the Institute, which were exhibited at the American Centennial Exhibition.

To these have been added a Map of a part of Annapolis County and a Map of a part of King's County, which were also made to illustrate papers read.

Geological Society.

I have referred to the abstract of my paper "on the Laurentian Rocks of Arisaig," which appeared in the Journal of the Geological Society. This, like many abstracts of papers not made by the authors, seemed to me not to do justice to my paper; still, I regard the abstract as valuable, as it is the first description of this interesting series of rocks in a scientific journal. I regard the nature of the discussion as also interesting and useful.

I would observe that the publication is also to be valued, as it led to the production of a very valuable note by Prof. T. Rupert Jones, on *Entomostraca* from Arisaig, "D. Upper series," which I had given to him in 1862.

Centennial Exhibition Phil., 1876.

When I saw the admirable stratigraphical collection of rocks

of the Canadian Geological Survey arranged in the Canadian Mineral Department, I was somewhat surprised to find a suite of specimens from George's River, Cape Breton, (the Cape Breton representative of my "Lower Arisaig series,"—vide. *Trans.*,) arranged with others from C. B. in the Laurentian division, I was led to believe that the Geological Survey still followed in the wake of "Acadian Geology." I was therefore not at all surprised to find Mr. Selwyn, the distinguished Chief of the Survey, describing to the International Judges of Class 100 the *Laurentian axis* delineated on a sketch map of Nova Scotia, and including in it George's River, Arisaig, and the Cobequid Mountains, as well as the Laurentian series of rocks of New Brunswick.

PRE-SILURIAN ROCKS OF CAPE BRETON.

August, 1876, I received the *Canadian Journal* containing Prof. Chapman's admirable "Outlines of the Geology of Canada." In the Cape Breton section I took particular notice of the Geology of Campbellton, Victoria County. Here the Pre-carboniferous rocks are described as Pre-silurian. These had been examined by the author, accompanied by Mr. Fletcher of the Geological Survey. In the vicinity of these are the Pre-silurian rocks of St. Ann, from which Mr. Hendry, Dep. Comnr. of Crown Lands, took the specimen of Ophicalcite which was exhibited in the Nova Scotian Department of the Exposition de Paris, 1867. This was the specimen referred to in which Sir C. Wyville Thompson found *eozonal* structure. There were also the rocks which Mr. Hartley, of the Geological Survey, considered to be of Laurentian age. Mr. Robb considered the Campbellton rocks to be of Quebec age.

Every Geologist that examined the Cape Breton Pre-carboniferous Crystalline rocks had thus come to form an opinion different from that expressed by the author of "Acadian Geology," who seemed still determined to maintain their Devonian or Upper Silurian age.

CORRESPONDENCE.

Not long after the receipt of the *Canadian Journal*, I re-

ceived a letter from the author of "Acadian Geology," requesting a copy of the *Transactions* of 1875-6, containing my papers, "A month among the Geological Formations of New Brunswick," and "Geology of Antigonish County."

On receipt of the *Transactions*, another letter was sent, in which he made some objections to my use of the terms Lower, Middle, and Upper Arisaig, stating that Geologists would never concede to one locality all the formations that I had assigned to it, at the same time proposing that I would call my "Lower Arisaig series" the "Cobequid Mountain series," and then he would accept of it.* I had adopted the nomenclature after *disposing* of the "Acadian Geology" division, and as a convenient and, to me at least, satisfactory method of indicating my operations in Pre-carboniferous Geology, especially at Arisaig, I could not see any valid reason for substituting any other local nomenclature in its stead, especially that preferred. If I were to consider it expedient to adopt any other, I would adopt "*George's River, C. B.*," which I associated with Arisaig in my paper of 1872, following the example of the Geological Survey in its maps and reports of Cape Breton. For the Middle Arisaig I would adopt Wentworth, I. C. R., Cobequid, A, (B being employed to represent the *Wentworth fossiliferous series.*) It was here that I first found occasion to adopt the term "Middle Arisaig." My "Upper Arisaig series" I would then call the "Arisaig and Moydart series," the last being the "Lower and Upper Arisaig" of Acadian Geology.

Considering that the Pre-silurian age of the "Lower Arisaig series" has now been established, and that it may be an open question for some time to come, whether the series be of Laurentian, Huronian, or Lower Cambrian age, I have no objections whatever to discontinue the use of the term "Lower Arisaig series," and to imitate the example of American Geologists in adopting the term "Archæan," under which Prof. J. Dana has already placed the typical Arisaig series. "Manual of Geology,"

*It appears, according to his own account, in his address as President of the Natural History Society of Montreal, the author of Acadian Geology in his last *Edition-Third*, has acted on his suggestion, and made a "Cobequid Series" and described it. He seems to have described my "Middle Series" but certainly not my "Lower Series" nor the George's River, C. B. Series.—Address Canadian Naturalist, New Series, Vol. 9, No. 3.

last edition. I would reserve "Middle" and "Upper Arisaig" *for further use.*

ARCHÆAN.

George's River, C. B.

The Arisaig Crystalline rocks were *per se* correlated with the Laurentian by comparison with the fine series of Laurentian rock specimens in the Canadian Department of the Exposition de Paris, 1867. Shortly after I thus correlated them I showed specimens to Sir W. E. Logan, who considered them to be of Quebec age. When I found the corresponding series at George's River, C. Breton, I came to the conclusion that both were of Quebec age, which was then regarded as corresponding with the Calciferous (Lower Silurian), and designated the typical series "Lower Arisaig." The discovery of an intermediate series in the Cobequids, which I designated "Middle Arisaig," led me to lower the horizon of the "Lower Arisaig." The subsequent examination of the Saint John, New Brunswick, Laurentian, led to the conclusion that the two were perfectly identical,—*vide* note on paper, "A month among the Geological Formations of New Brunswick," 1875-6.

Mr. Fletcher's very interesting discoveries of Primordial forms in strata overlying the Crystalline rocks of George's River, C. B., Lower Arisaig, tended to confirm the correlation with St. John Laurentian. Additional evidence is also furnished by his discovery of Upper Lingula flag forms at Marion Bridge, Mira River, C. B. To these I have to add the Rev. D. Sutherland's discovery of Primordial sandstone, with Lingulella sp., on Mira ridge, C. B.

NOTE.

I have just received from Mr. Selwyn, Director of the Dominion Geological and Natural History Survey, a *brochure* giving a very interesting account of his examinations of the Quebec formations of Canadian rocks. He proposes to adopt the following divisions of systems to include the groups enumerated.

I.—Laurentian. To be confined to all those clearly lower unconformable granitoid gneisses, in which we never find interstra-

tified bands of calcareous, argillaceous, arenaceous and conglomerates.

II.—Huronian. To include, 1st. the typical or original Huronian; 2nd, the Hastings, Templeton, Buckingham and Grenville group; 3rd, the supposed Upper Laurentian or Norian; 4th, the altered Quebec; 5th, the Cape Breton, Nova Scotia, and New Brunswick pre-primordial sub-crystalline and gneissoid group.

It thus appears that when I regarded the "Lower Arisaig series" as Laurentian, and then Quebec, and last of all, as identical with the New Brunswick, and therefore, Laurentian, I had not diverted very much from first to last.

The *Canadian Naturalist* of July, 1879, contains a paper read before the Natural History Society of Montreal, by McFarlane, Esq., in answer to Mr. Selwyn's pamphlet. In this he claims precedence in ascribing a *Cambrian* age to the Quebec Metamorphic rocks. It seems that this view of their age was expressed by him in a report to the Director of the Survey as early as 1862. If I had been fortunate enough to meet with this report when comparison of the Arisaig and George's River, C. B., with the Quebec rocks was instituted, I would have been prevented from making so great a change as from the Laurentian to the Calciferous, (Lower Silurian.)

Annapolis County.

Nictaux.

Fossiliferous Rocks.

Silurian, Gesner, 1849.

Devonian and Lower Helderberg, Dawson, 1868.

Middle Silurian, Honeyman, 1878.

When I examined the Nictaux formations, I had no recollection of the existence of the coral there, which had been considered a *Zaphrentis*, and referred to by the author of "Acadian Geology" in a note to my paper "on new Fossiliferous Silurian localities in Eastern N. S.," *Canadian Naturalist*, 1860, and also in "Acadian Geology," ed. 1868. I had only a faint recollection of anything that I had read about the Nictaux fossils, and I did

not wish to refresh my recollection, as I wished to examine them in the light of my own experience. This led me to identify the rocks with others with which I was well acquainted without any reference to the coral in question. The lithology and stratigraphical relations and familiar forms of fossils found in certain strata, enabled me to correlate the strata with the Middle Silurian formations of Eastern Nova Scotia, and led me to seek for other familiar forms, and to find them; *Petraia was notably one of the number.*

It is noteworthy that the *Devonian Zaphrentis* of Dawson is the *Petraia Forrestere* of Salter, occurring in strata referred by him to Mayhill Sandstone, (Intermediate Silurian of Ramsay and Salter). This is eminently characteristic of all the *Mayhill Sandstone* localities in Eastern Nova Scotia, which are eight in number. In one of these localities in the Marshy Hope, in the County of Antigonish, the Petraia strata seem to stand alone. In Barney's River, French River, and Sutherland's River, they are associated with Clinton and underlie it, other members of the Upper Arisaig series being absent.

At Lochaber the same strata are associated with C and D Upper Arisaig, and underlie them.

At Irish Mountain and McLellan's Mountain they are associated with B′ and D Upper Arisaig and underlie them. At Arisaig the Petraia strata (A) are associated with and underlie B, and the B′ Clinton of Hall and Dawson, C Aymestry Limestone, and D Upper Ludlow, or Lower Helderberg. In Irish Mountain and McLellan's Mountain the Petraia strata are Central Mountain strata in common with the extensive Diorites of *Devonian age.*

It is also *peculiarly* noteworthy that the author of "Acadian Geology," on the faith of "*one indistinct specimen of Zaphrentis,*" concluded that the *Petraia* strata of Lochaber was of Devonian age, and *re-asserted* the same opinion about 1874.

PRE-CARBONIFEROUS ROCKS OF THE PICTOU COAL FIELDS, OF DEVONIAN AGE.

In the Report of Progress of the Canadian Survey from 1866–9

page 7, Sir W. E. Logan says, in reference to certain pre-carboniferous rocks underlying the Pictou Coal Fields: "No evidence was observed by me on McLellan's Mountain, to show to what epoch these older rocks belong, but masses somewhat similar are noticed by Mr. Hartley on the west side of the East River, in a position where they have been mentioned in his Acadian Geology, by Dr. J. W. Dawson, who considered them to be of Devonian age, and on his authority they will be so distinguished."

In my criticism of this conclusion in Transactions 1870-1, 1st paper, I said: "I presume that this language is intended to apply to the area indicated on the S.E. corner of the map which accompanies Sir. W. Logan's Report, which is distinguished by the Devonian colouring. Now this area has its N. E. corner at the Falls of Sutherland's River, and its S. E. corner at the bridge at McPherson's Mills, so that in addition to the northern part of McLellan's Mountain, (range,) the area in question includes also a part of Sutherland's River."

In my second paper of the same session, Transactions page 141, I wrote: "The supposed Devonian rocks on the west side of East River, which are considered by Sir W. Logan to be "somewhat similar" to those of McLellan's Mountain, as indicated on Sir W. Logan's map, by a Devonian coloured area on the north west. Here the Pre-carboniferous rocks of Waters' Hill are regarded by Dr. Dawson as "probably of Devonian age,"—*vide* page 319 of "Acadian Geology" 1st Ed. It will be observed that this cautious expression hardly warrants the positive conclusion which Sir W. Logan derives from it."

When the question of the age of the Pre-carboniferous rocks of McLellan's Mountain had to be referred to the authority of "Acadian Geology," it would have been as well to make a direct reference. In 1855 the rocks in question were referred to the *altogether problematical* "Devonian and Upper Silurian, mostly metamorphosed,"—"Acadian Geology," 1855, map,—and no one had succeeded in finding evidence up to the time that Sir W. Logan examined them and found no evidence by which he could determine their age. i. e., 1868.

It was in the summer of 1869 when Mr. Hartley was working

alone in the Pictou Coal Field that I succeeded in identifying A, B′ and D of my Upper Arisaig series, (i. e, A Mayhill Sandstone, B′ Clinton, and D Upper Ludlow or Lower Helderberg), in Irish Mountain, McLellan's Mountain, and Sutherland's River, and in discovering characteristic fossils in them all. It was on this occasion that I identified the Mayhill Sandstone of Fraser's Mountain, (McLellan's Mountain range), and found Petraia afterwards in the same way that I identified Nictaux corresponding strata and found Petraia in them.

I also identified the same formation at Sutherland's River by the occurrence of *Petraia*, the rocks being unlike and the relations doubtful and found characteristic, *Athyris* and *Orthis* of A in like abundance, and of the same genera and species (undetermined) as at Lochaber, Arisaig, and Marshy Hope.

About the time that Sir W. Logan was writing his report, I read a paper before the Institute which I concluded thus:—"It may seem strange that during my description of the area underlying the Pictou Coal Field, I have made no mention of the Devonian formation which is *so often spoken of* in connection with the strata underlying the coal field. The reason why is this,—*there is no Devonian to be found there*."—*Transactions*, 1870–1, page 75. I felt called upon the following session, 1871–2, to maintain the conclusion arrived at, after the appearance of Sir W. Logan's Report on the Pictou Coal Field, which I did by adducing the evidence which I had discovered in Irish Mountain, McLellan's Mountain, and Sutherland's River, in opposition to Sir W. Logan's views, evidence which has not yet been called in question, but which the author of "Acadian Geology," in accordance with his views on Lochaber and Nictaux, would have regarded as confirming the opinion expressed by Sir William Logan, founded on his authority.

An application of the preceding to views entertained regarding Nictaux is obvious, but as the Devonian age of the Lochaber Petraia strata was inferred by the author of "Acadian Geology" from a specimen of Petraia which was Zaphrentis, "a cast not sufficiently perfect for specific determination, but not unlike imperfect specimens from the Devonian of Nictaux."—*Canadian*

Naturalist, Aug., 1866, page 199. I do not consider the application as of much importance.*

CORRECTION.

I used the expression "antiquated" in characterizing the views of Sir W. E. Logan. This was an improper application of the word to Sir W.'s views as expressed in 1870. I then had reference to the views entertained in 1855, and did not consider that it was my own observations in 1869 that disposed of the Devonian at McLellan's Mountain.

GRANITES.

Archæan.

In the typical "Lower Arisaig series" granites have not yet been found. Quartz veins with mica are found penetrating the Petrosiliceous rocks of the series. In Cape Breton coarse granites are of very frequent occurrence among rocks of the series. In the Cobequid Mountains they also occur. In this respect the rocks of this series correspond with the Laurentian formation of Saint John, New Brunswick. I consider these granites to be the *oldest* in Nova Scotia, i. e., according to present appearances.

HALIFAX, SHELBURNE, ETC.

Granites.

"The Granite of Nova Scotia and its associated gneisses and Mica slates are among the oldest rocks found in the Province."—"Acadian Geology," 1868, page 622.

NICTAUX.

"As the Granite is itself of Devonian Age." "Acadian Geology," page 500.

Sir Wm. E. Logan, the late Director, regarded, and Mr. Selwyn, the present Director of the Geological Survey of Canada, regards the Granites as all of the same age—*Devonian*.

Professor H. Y. Hind considers the Cape Breton and Nova Scotian Granites to be Laurentian Gneisses.

I have shown in my paper "on Geology of Annapolis County—Nictaux," that the Granites underlie (almost unaltered) Middle

* NOTE.—I have just examined the Geology of the Moose River Iron deposits. They amply confirm my opinion regarding Nictaux deposits.

Silurian—possibly Lower Silurian strata, and therefore that that they are of "pre-Middle Silurian" age. I have also demonstrated that a Gneissoid connection of this Granite and *phenomena* are precisely similar to what are observed at Halifax, and that there is not sufficient grounds for assigning one age to one and another age to another.

All our Granites seem to be of *Archæan Age.* In the case of the Halifax Granites, as well as those of Nictaux, there seems to have been a *re-metamorphism* effected during Upper Cambrian and part Lower Silurian time.

In a paper which I am preparing "on the Geology of Halifax" I will give my reasons for the conclusion stated.

ART. XI.—FISH CULTURE.—BY JOHN T. MELLISH, M. A., *Principal of Albro Street School, Halifax, N. S.*

(*Read May* 12, 1879.)

THE subject of fish culture, or the propagation of various kinds of fish by artificial means, has within the past few years received considerable attention on both sides of the Atlantic. As a branch of economic industry, the culture or breeding of trout, shad, oysters, salmon and other kinds of fish used by man as food, cannot be too carefully attended to by the State, and especially so, when such artificial breeding seems to be the only remedy for re-stocking depleted rivers and streams. My object in preparing this paper is to place on record in connected form a short history of fish culture in our own country. In doing this, I shall touch very briefly on the subject as referring to other countries. The culture of the salmon, and, to some extent, the white fish, is all that has been attempted as yet in Canada. As the Institute was favored a short time since with a most excellent paper on the Salmon by a distinguished member of this body, Dr. J. B. Gilpin, it is not at all necessary that on the present occasion I should refer, except incidentally, to the various stages of growth and development through which the fish passes, from the time it leaves the ova till it becomes the full grown salmon, beautiful to the eye, delicious to the taste. The peculiar instinct of the

salmon, shad, and some other fish, in seeking the river where they emerged from the egg and were deposited after being hatched, in order to spawn, after having acquired their wonderful growth in salt water, renders it possible not only to re-stock a depleted river, but to introduce a larger run of fish than originally frequented the river. Salmon will seek their native water, even if only a small stream. It is computed that 90 p. c. of the ova *is lost* when the spawn is deposited in the river, and that 90 p. c. is hatched when deposited in charge of the fish breeder.

Fecundated fish spawn has been an article of traffic among the Chinese from time immemorial. The Romans, who, as their old writers inform us, used fish at their tables of various kinds and of the choicest quality, resorted to artificial culture to supply the demand. We are told that Lucullus, at his house at Tusculum, on the shores of the Bay of Naples, dug canals for his fish ponds to the sea; that fresh water streams were led into these canals; that sea fish having passed up into the ponds and deposited their ova were prevented from returning to the sea by flood gates; and that the yearly value of the fish kept in these ponds amounted to a sum equal to $250.000. After the fall of the Roman Republic fish culture does not seem to have been practiced until the 14th century, when Dom Pinchon, a monk of the Abbey of Reome, bred fish in wooden boxes. He was the first who expressed the ova and applied the male milt to it. The ends of these boxes were of wicker work, their bottoms being covered with sand on which the ova were deposited. An interim seems to have ensued when no interest was taken in the art. In 1763, Jacobi, a German, began experiments which he carried on for thirty years. Others soon took an interest in the matter, and about the year 1834 Messrs. Shaw and Young, of Scotland, bred salmon in wooden boxes. Joseph Remy, a French peasant, successfully experimented in 1849 in re-stocking with young fish many depleted rivers and streams. During the past twenty years salmon culture has been carried on with great success in Scotland and Ireland. In many cases large fortunes have been accumulated in the business by private individuals. Consider-

able attention has also been given to the subject in the United States, but the Americans are free to confess that the facilities in Canada for salmon culture are much greater than in their own country. In several of the Eastern States the culture of the common brook trout has been carried on successfully.

Artificial fish culture was first introduced into Canada by Mr. Samuel Wilmot, a native of the Province of Ontario. Having been brought up in the immediate vicinity of a once famous salmon producing river, and having observed the gradual decline in the numbers of this fish entering the stream, Mr. Wilmot conceived the idea of endeavoring to re-stock it by artificial means, somewhat after the manner practised at Stormontfield in Scotland, and at Huningen in Germany. His first attempt was made in the year 1866. Having then no practical knowledge of the details of the work, his operations were necessarily limited and rather unsuccessful. The art of manipulating the fish and of impregnating the ova obtained from them required close study and experience. Mr. Wilmot, being exceedingly ingenious and a man of great determination, was nothing daunted by failure, but continued year after year to renew his attempts to overcome the difficulties before him, and was highly gratified to find in the year 1870 that he had mastered the art and was able to take the ova from the mother fish without injuring her, and after fecunding them by the milt or impregnating fluid obtained from the male fish, was able to keep them safely during their long period of incubation, and finally to deposit them safely in the river. Having accomplished this much entirely at his own expense, and being convinced of the practical utility of the work in re-stocking the almost depleted rivers of his native Province, he brought the matter before the Dominion Government and asked for a small appropriation which would enable him to perfect and extend his scheme. Up to this time Mr. Wilmot's operations and experiments had been carried on in his own cellar, through which a small stream of water passed, but as no extensive results could be secured in so limited a space, he was anxious to obtain more suitable accomodation. Mr. Wilmot then succeeded in obtaining a sufficient sum from the Dominion Government

to permit of his erecting a suitable hatchery in which to prosecute his experiments on a more extensive scale. The first salmon hatchery, built in 1870, was located on Wilmot's creek, near the village of Newcastle, Ontario. In this building a number of hatching troughs were placed, in which were laid the impregnated ova, each trough being fed by a small stream of water supplied from a large tank or reservoir placed at one end of the building. Previous to this time Mr. Wilmot's experiments had been confined to comparatively small numbers of ova, but now, having increased space and better facilities, he was anxious to deal with hundreds of thousands of them. By the most determined effort and diligent labour, he succeeded in procuring about 250.000 ova. Having been very successful in hatching this number and depositing them in several of the rivers in the vicinity of the hatchery, additional means were furnished him still further to increase the facilities for carrying on the work. The then Minister of Marine and Fisheries being convinced of the great utility of the scheme, decided to carry the work into the Maritime Provinces, where the most valuable fisheries existed. He accordingly, in the year 1872, had $20,000 placed in the estimates for the year for fish breeding and fish ways, and in 1873 was completed the first hatchery built in these Provinces. This was situated on the far famed Restigouche river, the boundary between the Provinces of Quebec and New Brunswick. During this year another hatchery was commenced at Gaspe in the Province of Quebec, and still another on the Miramichi in New Brunswick. In 1874 these three establishments were fully completed, and each year since they have turned out their quota of salmon and other fish. Encouraged by the success attending these hatcheries, the Fisheries Department in 1875 extended the work to Nova Scotia, and erected on the Sackville river, at the head of Bedford Basin, another establishment. This hatchery was located by Mr. Samuel Wilmot who had previously been appointed superintendent of Fisheries for the Dominion, and was completed and opened by Mr. A. B. Wilmot, one of the oldest apprentices at the work. Mr. A. B. Wilmot's extensive and varied experience gained

while in the work at the older institution in Newcastle, Ontario, and afterwards while in charge of the hatcheries at Gaspe and Miramichi, has enabled him to introduce into the Bedford establishment the most improved and serviceable appliances for prosecuting the work on a large scale. Among these appliances which are as yet only used in his establishment, but which will shortly be introduced into the others, are 1st, a set of filterers for preventing the foul sediment from coming in contact with the ova, and thereby injuring them; 2nd, a new description of tray or hatching grill, upon which the ova are placed during the season of incubation; these trays are of the ordinary earthenware, covered with a thin salt glazing, and were introduced to prevent the possibility of any chemical action which might injure the young fish, between the iron and sulphur contained in the water and the zinc of the trays previously introduced by Mr. Samuel Wilmot, and which up to this date were the only trays used; 3rd, a simple but most serviceable escape or overflow pipe, which will permit any required quantity of water to pass through the hatchery trough, while no young fish can possibly escape. Aided by these improvements, Mr. A. B. Wilmot has been enabled to achieve a degree of success comparatively greater than that attained in any of the older establishments. As it was impossible to obtain from the Sackville River a sufficient number of the parent fish, from which to obtain a full stock of ova, recourse was had to some remote rivers of this province, principally River Philip in Cumberland county, West River in Pictou county, and the Annapolis and Musquodoboit Rivers. Those rivers producing the largest salmon were chosen in preference to the others, the object being to re-stock the depleted rivers with a larger run of fish than formerly frequented them. At convenient points auxiliary establishments or reception tanks and spawning sheds are erected, in which to confine the salmon and perform the delicate and important work of manipulating. The result of Mr. Wilmot's labours for the three years this establishment has been in operation, has been the hatching and distributing among thirty-five rivers of this Province, the large number of 3,000,000 Salmon, 160,000

White Fish, and 8000 Salmon Trout, the latter having been obtained from the lakes of Ontario. He has at the present time (April, 1879) 1,800,000 Salmon hatched, and in a few days will commence to distribute them among the most suitable rivers within reach of the hatchery. This will make a total of 4,800,000 salmon distributed from this one hatchery, in the short space of four years. The Bedford Establishment, although one of the smallest in the Dominion, has a hatching capacity of 2,500,000. There are at present eight fish-breeding establishments in the Dominion: two in Ontario, four in Quebec, one in New Brunswick, one in Nova Scotia; and it is proposed to erect an additional one, during the present summer, in New Brunswick. P. E. Island is certainly entitled to one. There will probably be distributed during the next four weeks from the hatcheries now in operation, within the Dominion, about 40,000,000 young fish, of which about 30,000,000 are the White Fish of the great lakes of the west. No doubt the culture of the Trout, the Oyster and the Shad will receive attention in Canada at an early day.

ART. XII.—EXPERIMENTAL MICROSCOPY.—BY J. SOMERS, M. D., *Professor Physiology, Microscopy, &c., Halifax Medical College.*

(*Read May 12th*, 1879.)

THIS short essay owes its existence to a wish expressed by members of the Council of the Institute.

It contains nothing original, or what any person familiar with the use of the Microscope, does not already understand. It was prepared to accompany a series of experiments presented to the members, and it does not pretend even to explain the nature of these, nor of the specimens exhibited.

The writer feels complimented in that he has been requested to fill at the final meeting of this season, a vacancy which has occurred for the first time for many years. One who never failed to present the results of his observations at the final meeting of the session, has closed his earthly labors. Endeared as he was to us all, not only for his zeal and arduous toil in the cause

of science, but also for possessing those qualities of head and heart which constitute the true gentleman; his death has caused a vacancy in our ranks, which time will scarcely obliterate. The memory of his scientific and personal worth will ever recur to remind us of the loss which science and our Institute has sustained.

Our subject for to-night is appropriate, in view of the honour recently conferred upon us by the Royal Microscopical Society of London. The fellowship which comes to our President, while he is in office, is a tribute to work which has been done by our body, and every member should feel a reasonable pride in the distinction, inasmuch as it is given in appreciation of work which all have tended to forward; furthermore we have reason for congratulation in the circumstance that the honour has fallen upon right worthy shoulders, those of a pioneer in the cause of science.

It would be out of place to take up your time in describing the construction, or even the history of the Microscope. Its beginnings, like that of many useful inventions, were very simple; the lenses with which Leuwenhoeck discovered the blood corpuscles, and Malpighi the capillary circulation, when compared with the compound Microscope of to-day, tells at a glance of the vast strides which microscopy has made within the two centuries which have passed since it began to be applied to the study of Biology. It will enable us also to comprehend and appreciate its value to the student of science, in opening to his bodily and mental vision fields of observation, which without it could never be explored.

A glance through the instruments before you will reveal that sublime sight which the immortal Harvey is said to have never beheld, "the circulation of the blood in the capillary blood vessels." This discovery was made twenty-six years subsequent to Harvey's publication of his discovery of the circulation through the heart and great vessels.

The development of the young Salmon from the ova can now be easily observed; and the various changes, from the swelling of the blastoderm to the formation of the perfect minnow, are very interesting. Embryology may be said to date as a scientific

study from the time, 1672, when Regnerus De-Graaz applied the Microscope to its elucidation.

The infusoriæ, so called, are very interesting to the Microscopist. The multitude of forms, variety of structure, uncertainty of the position of many of them, whether they belong to the animal or vegetable kingdom, increase their value as objects for study. They afford an immense field for original research, but partly explored. Here we find the battle ground where Vitalist, Evolutionist and Panspermatist can wage intellectual warfare.

The Microscope has rendered invaluable service in exploding false ideas and crude theories. If we take for example the spontaneous generation theory. Assuming all animals, the mode of whose generation is unknown or obscure, owe their origin to the spontaneous efforts of nature acting by force upon inorganic matter, the extent of its application would be proportionate to the sum of our knowledge of sexual generation, or of generation by division; hence, in looking backward at the history of this theory, we find it always resting on an ever shifting base; accepted by the ancients, it sufficed to explain the generation of reptiles, fishes, insects, and all animals of whatever kind, whose mode of re-production was unknown.

The study of the embryology of these creatures have satisfied all doubts relative to their re-production, yet are we very much in the position of the scientific world in the time of Aristotle, heterogeny is still received by many as a scientific fact, the base being shifted to a still lower stratum of life, where the process of reproduction is obscure or not yet known. The question then arises, have we really a spontaneous origin of minute beings; or is there a possibility of the existence of a process of generation amongst them, of which we are ignorant? We are, so far as this question extends, in the position of our predecessors, previous to the discovery of the Microscope. We cannot account for the existence of a Bacterium by reproductive generation, therefore it is generated spontaneously, if so, why not a snake? as Kercher believed. Writing to Redi, he gives the following recipe for manufacturing snakes:—

"Take some snakes, of whatever kind you want, roast them,

"and cut them into small pieces, sow these in an oleaginous soil, "sprinkle from day to day with water, taking care that the piece "of ground be exposed to the spring sun, and in eight days you "will see the earth strewn with little worms, which, being "nourished with milk diluted with water, will gradually increase "in size till they take the form of perfect serpents."—*Kercher Mund. Subterran.*

Redi determined to prove the recipe, and in doing so, exploded his friend's theory. He says:—

"Moved by the authentic testimony of this most learned "author, I have frequently tried the experiment, but I could "never witness the generation of those blessed snakelets made to "hand."—*Redi, Generat, Insectorum, 1686.*

Redi however found an abundant progeny of Maggots, which, being confined in a covered box, weie in a short time transformed into flies. To Redi's observations science is indebted for some of the earliest definite knowledge of the generation and metamorphoses of insects.

If one of the ablest men of his time, which Kercher undoubtedly was, will to us appear at a disadvantage, because he too readily accepted a false theory, how careful we should be lest our successors a century or so hence may be in a position to subject our theories and experiments to the criticism of ridicule. The substitution of infusions of chopped hay or turnips in water and exposure to sunlight, for chopped snakes, milk, and sunlight, is startlingly like a repetition of the old process, and is likely to be followed by equally satisfactory results.

The revelations of the microscope in all that relates to the process of generation so far as positive facts are concerned, tend to prove the truth of the proposition that every living organism has been generated or produced by a pre-existing living organism. The theory of spontaneous generation had fallen into disregard until certain observations of Pouchet, put forward in the year 1847, caused its revival. Pouchet in his experiments seemed to show that certain infusorial animalcules were generated spontaneously, but subsequent experiments of Balbiani, in 1861, demonstrated the existence of sexual generation in these

organisms, heterogenists had then to recede a step,—new organisms were needed to uphold the theory. Bacteriæ came to the front.

The theory of spontaneous generation may perhaps be resolved by the question: Do living organisms come from, 1,—a spontaneous aggregation of particles, living or inorganic? 2.—Are they the result of the development of ova? Spontaneous action is defined to be that arising from natural disposition, tendency or inclination, or without external cause, that is, no cause can be assigned for its production—a confession of ignorance.

All that is positively known of the reproduction of living beings points to sexual generation as the means by which nature attains that object, even accepting certain variations of the process. If we reason from the supposition that living beings are formed by the fortuitous aggregation of particles, organic or inorganic, we assume a fact of which we have no example in nature by analogy, and one which we are incapable of demonstrating. We assume likewise that such aggregation or combination of molecules is capable of producing beings of a definite and uniform character, for which we have no basis.

If we on the other hand suppose the production of the lowest orders of beings to be owing to the development of germs or ova, separated from living beings of their own kind, finding suitable conditions, we rest upon a basis which is analagous to what occurs in all cases where the process of reproduction can be seen and followed, confessing merely our inability as yet to demonstrate the process by which it is brought about.

The conclusion we arrive at from the foregoing is that living organisms reproduce beings like themselves, through successive generations, and life passes down the pathway of time always reproducing itself; that the mind of man, also a product of living matter, like that matter, is constantly reproducing itself, and often, when supposing it has arrived at the termination of a linear course, finds that it has only travelled in a circle. It seems to me that the only true philosophic view to take of the question is to assume that there is in nature no such thing as a spontaneous generation, admitting, however, the exact mode of production of the lowest forms is not at the present time understood.

APPENDIX.

LIST OF THE FISHES OF NOVA SCOTIA.

(Corrected to date, 1879.)

BY J. MATTHEW JONES.

THE following list comprises all the Fishes recorded to date as occurring in our waters. A few other fluviatile species doubtless exist in the more remote lakes and streams of the interior, and we may look forward to the occasional occurrence of additional boreal marine forms on our northern fishing banks, brought there under the influence of the cold arctic current which bears annually its burden of icebergs from Davis' Strait; while the number of southern marine forms may also be augmented at intervals, by errant examples, thrown off during their northerly course, along the heated waters of the Gulf Stream.

In the preparation of this list the author has received the generous assistance of his much esteemed friend, Prof. G. BROWN GOODE, of the Smithsonian Institution, Assistant U. States Fish Commission, who has kindly furnished a list of hitherto unknown species, procured from our fishing banks by the Commission during the past three years, and revised in part the nomenclature.

Fam. GASTEROSTEIDÆ.

1. GASTEROSTEUS ACULEATUS, *L.* Two-spined Stickleback. Common.

Fam. PERCIDÆ.

2. PERCA FLUVIATILIS, *L.* Perch. *Perca flavescens,* Stor. Common in most lakes and streams.
3. ROCCUS LINEATUS *(Schn.) Gill.* Striped Bass. *Labrax lineatus,* Gunth. Common.
4. MORONE AMERICANA *(Gmel.) Gill.* White Perch. *Labrax rufus,* Gunth. Common.

Fam. TRIGLIDÆ.

5. SEBASTES MARINUS (*L.*) *Lutken; S. Norwegicus.* Gunth. Common; taken on the banks while fishing for cod.
6. COTTUS SCORPIUS, *L.* Sculpin. Very common.
7. C. OCTODECIM-SPINOSUS, *Mitch.* Not common.
8. CENTRIDERMICHTHYS UNCINATUS, *Reinh.* Fishing banks off the coast (U. S. F. C.)
9. TRIGLOPS PINGELII, *Reinh.* Fishing banks off the coast, (U. S. F. C.)
10. ASPIDOPHOROIDES MONOPTERYGIUS, *Bloch., Storer.* Obtained from fish stomachs.

Fam. SCOMBRIDÆ.

11. SCOMBER SCOMBRUS, *L.* Mackerel. *Scomber scomber,* Gunth. As on other coasts this fish is more abundant some seasons than others; attributable no doubt to the ample food supply, or scarcity, as the case may be. It generally consists of the minute fry of other fishes; but when that particular food fails, they appear to resort to the minute crustacea. Dr. Gilpin carefully describes this species in Trans. N. S. Inst. Nat. Science, vol. I., Pt. 4, p. 11.
12. ORCYNUS THYNNUS (*L.*) *Goode.* Albicore. *Thynnus thynnus,* Gunth. Common in the bays and harbours during the months of July and August.
13. O. ALATUNGA, (*L.*) *Gill.* *Thynnus alalonga,* Gunth. According to Messrs. Goode & Bean's admirable List of Fishes of Massachusetts Bay, (1879) a specimen was obtained by Capt. William Thompson, of the schooner "Magic" of Gloucester, in the Summer of 1878, on Banquereau, at a depth of 300 fathoms.
14. SARDA PELAMYS (*L.*) *Gunth, Cuv.* Bonito. *Pelamys sarda,* Not common. A young example captured at the mouth of Halifax Harbour is now in the Museum collection.
15. ECHENEIS ———— ? Suck-fish. A specimen in the Halifax Museum not yet determined.

16. Poronotus triacanthus (*Peck.*) *Gill.* *Stromateus triacanthus*, Gunth. Common.

17. Lampris luna, *Riss.* Very rare. A specimen was taken at Sable Island some years ago, a rough sketch of which, with the colours well depicted, was made by one of the men belonging to the establishment there, and given to Dr. Bernard Gilpin, in whose portfolio I saw it and carefully examined it. Although the sketch was rude in the extreme, the peculiar form and brilliant colours left no doubt as to the fish. The man had never seen one before.

Fam. CARANGIDÆ.

18. Paratractus pisquetus (*Cuv. & Val.*) *Gill.* *Caranx chrysos*, Gunth. Not uncommon.

19. Argyriosus vomer (*L.*) *Cuv.* & *Val.* Not common. Specimens are occasionally taken in shore waters.

20. Pomatomus saltatrix (*L.*) *Gill.* Blue-fish. *Temnodon saltator*, Gunth. Inserted on the authority of Dr. Bernard Gilpin, who has seen specimens taken on this coast.

Fam. XIPHIIDÆ.

21. Xiphias gladius, *L.* Sword-fish. Occasionally taken in the bays and harbours.

Fam. DISCOBOLI.

22. Cyclopterus lumpus, *L.* Lump-fish. Very common.

23. C. spinosus, *Fabr.* Very rare. Trawled off Halifax Harbour by the "Speedwell" Expedition, August, 1877. (U. S. F. C.)

24. Liparis vulgaris, *Flem.* Common.

25. L. Montagui, *Don.* Rare. Taken off Halifax Harbour by the "Speedwell" Expedition, Aug., 1877. (U.S.F.C.)

26. L. ranula, *Goode* & *Bean.* Very rare. One specimen only has been obtained by the "Speedwell" Expedition off Chebucto Head, Halifax Harbor, at a depth of 52 fathoms. (U. S. F. C.)

Fam. PEDICULATI.

27. Lophius piscatorius, *L.* Devil-fish. Common.

Fam. BLENNIDÆ.

28. Anarrhichas lupus, *L.* Cat-fish. Common.
29. A. minor, *Olaf.* Fishing banks off the coast (U. S. F. C.)
30. A. latifrons. *Steenst & Hallg.* Fishing banks off the coast (U. S. F. C.)
31. Leptoclinus aculeatus (*Reinh.*) *Gill. Stichæus aculeatus*, Gunth. Fishing banks off the coast (U. S. F. C.)
32. Eumesogrammus subbifurcatus (*Storer*) *Gill. Pholis subbifurcatus*, Stor. Taken off Halifax Harbour by the "Speedwell" Expedition (U. S. F. C.)
33. E. unimaculatus (*Reinh.*) *Goode & Bean. Stichæus unimaculatus*, Gunth. A specimen was forwarded by Mr. Whiteaves from the vicinity of Anticosti to the Smithsonian Institution. See Goode & Bean's List of Fishes of Mass. Bay.
34. Murænoides gunnellus (*L.*) *Goode & Bean.* Common in shore waters. Described by the author, Trans. N. S. Inst. Nat. Sc. vol. I. Pt. I. p. 50.
35. Cryptacanthodes maculatus, *Stor.* Wrymouth. Occasionally taken. The variety *C. inornatus*, Gill—is not uncommon.
36. Zoarces anguillaris (*Peck.*) *Storer.* Common.

Fam. ATHERINIDÆ.

37. Chirostoma notatum (*Mitch.*) *Gill. Atherinichthys notata*, Gunth.

Fam. FISTULARIIDÆ.

38. Fistularia tabaccaria, *L.* Occasional specimens taken in shore waters during the summer months. A specimen in the Halifax Museum.
39. F. serrata, *Cuv.* Like the last species this is occasionally taken in shore waters. The author examined a fine specimen 31 inches in length including caudal filament in Sept. 1863, which had been taken at Portu-

guese Cove, Halifax Harbour. A small specimen is in the Halifax Museum. There can be hardly a doubt as to the distinctness of these two species.

Fam. LABRIDÆ.

40. TAUTOGOLABRUS ADSPERSUS (*Walb.*) *Gill.* Sea Perch. *Ctenolabrus burgall*, Gunth. Very common during the summer months in harbours and bays. The variety *uninotatus*, having a black spot at the base of the two anterior soft dorsals rays, mentioned by Gunther, Cat. Fishes, vol. iv., p. 90, is found in company with it.

Fam. LYCODIDÆ.

41. LYCODES VAHLII, *Reinh.* Fishing banks off the coast, (U. S. F. C.)
42. L. VERRILLII, *Goode & Bean.* Fishing banks off the coast, (U. S. F. C.)
43. L. PAXILLUS, *Goode & Bean.* A single specimen obtained between La Have and Sable Island Banks, recorded in Messrs. Goode and Bean's List of N. E. Am. Fishes (1879) p. 9.

Fam. GADIDÆ.

44. GADUS MORRHUA, *L.* Cod. Very common.
45. G. TOMCODUS, *Mitch.* Frost-fish. Very common.
46. G. ÆGLEFINUS, *L.* Haddock. Very common.
47. G. POLLACHIUS, *L.* Pollack. Very common. Large schools come into Halifax Harbour about the latter end of June or beginning of July, to feed upon the fry of the common hake.
48. MERLUCIUS BILINEARIS (*Mitch.*) *Gill.* Whiting. *Merluccius vulgaris*, Gunth. Not common.
49. PHYCIS CHUSS (*Walb.*) *Gill.*
50. P. TENUIS (*Mitch.*) *De Kay.* Hake. *Phycis americanus*, Gunth. Very common.
51. P. REGIUS (*Walb.*) *Jord. & Gilb.* *Phycis regalis*, Gunth. Sir John Richardson gives Halifax as a locality for this species. *Faun. Bor. Am.*

52. Haloporphyrus viola, *Goode & Bean.* Fishing banks off the coast (U. S. F. C.)

53. Onos (Rhinonemus) cimbrius (*L.*) *Goode & Bean. Motella cimbria*, Gunth. Fishing banks off the coast (U. S. F. C.)

54. Brosmius brosme (*Mull.*) *White.* Cusk. Common.

55. Ammodytes americanus, *De Kay.* Sand Eel. Common; burying in the sand at ebb of tide, and going in schools at high water.

Fam. PLEURONECTIDÆ.

56. Hippoglossus vulgaris, *Flem.* Halibut. Very common on the fishing banks off the coast.

57. Hippoglossoides platessoides (*Fabr.*) *Gill.* Arctic Flounder. *Hippoglossoides limandoides*, Gunth. Not uncommon. Of two specimens forwarded by the Rev. J. Ambrose from St. Margaret's Bay, the largest measured twenty-two inches in length.

58. Pseudopleuronectes americanus (*Walb.*) *Gill.* Flounder. *Platessa plana*, Stor. Very common in shore waters. Described by the author, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. I., p. 51.

59. Limanda ferruginea (*Storer.*) *Goode & Bean. Pleuronectes ferrugineus*, Gunth.

60. Platysomatichthys hippoglossoides (*Walb.*) *Goode & Bean.* Turbot. *Hippoglossus groenlandicus*, Gunth. Occasional specimens are brought in from the northern fishing banks, but it is more common off Newfoundland. It is a very oily fish when cooked.

61. Glyptocephalus cynoglossus (*L.*) *Gill. Pleuronectes cynoglossus*, Gunth. La Have fishing bank (U.S.F.C.)

Fam. SILURIDÆ.

62. Amiurus catus (*L.*) *Gill.* Not common. This fish is very tenacious of life, for a specimen survived being carried wrapped up in paper in a pocket for two hours.

Fam. SALMONIDÆ.

63. Salmo salar, *L.* Salmon. More abundant some years

than others. Described by Dr. Gilpin, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 4, p. 76.

64. S. CANADENSIS, *Hamilton Smith.* Sea Trout. Very common at the mouths of rivers, May to August. Dr. Gilpin has described the species, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 4, p. 84.

65. S. GLOVERII, *Gir.* This fish under the name of "Grayling" is known in most rivers and lakes. It is probably from its light colour that it obtained the name, for it does not belong to the genus *Thymallus.* Described by Dr. Gilpin, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 4, p. 86.

66. CRISTIVOMER NAMAYCUSH (*Penn.*) *Gill & Jordan.* Lake Trout. *Salmo namaycush,* Gunth. Common in the larger lakes where it is known to the countrymen as the "pickerel." It is well described by Dr. Gilpin in Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 4, p. 88.

67. SALVELINUS FONTINALIS (*Mitch.*) *Gill & Jordan.* Brook Trout. *Salmo fontinalis,* Gunth. Very common in all lakes and streams. Described by Dr. Gilpin, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 4, p. 81.

68. OSMERUS MORDAX, *Mitch.* Smelt. *Osmerus viridescens,* Gunth. Very abundant in January and February, when they are taken through holes in the ice in great quantities.

69. MALLOTUS VILLOSUS, *Cuv. & Val.* Capelin. Occurs as far south as Halifax only occasionally, when the temperature of the shore waters is lower than usual. Its proper habitat is further north, on the coasts of Newfoundland and Labrador. Described by the author, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 2, p. 5.

Fam. SCOMBRESOCIDÆ.

70. SCOMBRESOX SAURUS, *Flem.* Bill Fish. Not uncommon during the summer months. A specimen preserved in the Halifax Museum jumped out of the water into a fishing-boat. The fishermen say it comes with

the mackerel. We are informed by Mr. Robert Morrow that it is seen on the coast of Cape Breton in schules during the month of August.

71. EXOCÆTUS ————? Flying-fish. A specimen was taken at Sable Island in 1859, but the species was not determined.

Fam. CYPRINODONTIDÆ.

72. FUNDULUS ——— sp.? Minnow. A species not yet determined; in all lakes and streams.

Fam. CYPRINIDÆ.

73. CATOSTOMUS TERES (*Mitch.*) *Les.* Sucker. Common in most streams.

74. ERIMYZON SUCETTA (*Les.*) *Jordan.* *Moxostoma sucetta,* Gunth.

Fam. CLUPEIDÆ.

75. CLUPEA HARENGUS, *L.* Herring. More plentiful some seasons than others. Described by Dr. Gilpin, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 1, p. 4.

76. ALOSA SAPIDISSIMA (*Wilson*) *Storer.* Shad. Abundant on the west coast Bay of Fundy. Described by Dr. Gilpin, Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 4, p. 107.

77. POMOLOBUS VERNALIS (*Mitch.*) *Goode & Bean.* Gaspereau. Very abundant.

78. BREVOORTIA TYRANNUS (*Latrobe*) *Goode.* Menhaden. On the authority of Dr. Gilpin.

Fam. MURÆNIDÆ.

79. NEMICHTHYS SCOLOPACEUS, *Rich.* *Nemichthys scolopacea,* Gunth. Fishing banks off the coast, (U. S. F. C.)

80. SYNAPHOBRANCHUS PINNATUS (*Gronow*) *Gunth.* Fishing banks off the coast (U. S. F. C.)

81. ANGUILLA VULGARIS, *L.* Eel. Very common.

Fam. SYNGNATHIDÆ.

82. SYNGNATHUS PECKIANUS, *Storer.* Pipe-fish. Common in shore waters.

83. Hippocampus antiquorum, *Leach.* Occasionally taken during the summer months; a Gulf-stream migrant no doubt.

Fam. SCLERODERMI.

84. Balistes capriscus, *Gm.* A specimen taken at St. Margaret's Bay, is in the Halifax Museum.

85. Stephanolepis setifer, *Bean.* *Monocanthus setifer.* Gunth. Occasional specimens are taken in shore waters. The Rev. John Ambrose kindly forwarded one to the author about twelve years ago which was secured at St. Margaret's Bay. It is described in Trans. N. S. Inst. Nat. Sc., Vol. I., Pt. 1, p. 53.

Fam. GYMNODONTES.

86. Mola rotunda, *Cuv.* Sun-fish. *Orthagoriscus mola,* Gunth. Rare. A specimen five feet six inches in length taken in Halifax Harbour, October, 1873. Described by Dr. Gilpin, Trans. N. S. Inst. Nat. Sc., Vol. III., p. 343.

Fam. ACIPENSERIDÆ.

87. Acipenser sturio, *L.* Sturgeon. Occasionally taken.

Fam. LAMNIDÆ.

88. Alopias vulpes (*L.*) *Bon.* *Alopecias vulpes,* Gunth. Thresher. Occasionally taken in fishing nets, to their great detriment. A fine specimen in the collection of King's College, Windsor, N. S.

89. Cetorhinus maximus (*L.*) *Blainv.* Basking Shark. *Selache maxima,* Gunth. From descriptions given by different observers we have no doubt as to the occurrence of this species on the coast.

Fam. SPINACIDÆ.

90. Squalus acanthias, *L.* Dog-fish. *Acanthias vulgaris,* Gunth. Common on the fishing grounds.

91. Centroscyllium Fabricii (*Rein.*) *Mull. & Henle.* Fishing-banks off the coast (U. S. F. C.)

92. CENTROSCYMNUS CŒLOLEPIS, *Bocage & Capello.* Abundant on the fishing banks off the coast (U. S. F. C.)

93. LÆMARGUS BOREALIS, *Mull. & Henle.* Greenland Shark. The only specimen of this rare northern form the author has had the opportunity of examining, was taken off Halifax Harbour in February, 1863, and afforded the following description:—Body fusiform, narrow at the tail. Extent from tip of snout to caudal extreme 11 ft. 3 in. Depth at deepest part, a distance of 1 ft. from posterior branchial aperture, 2 ft. 4 in.; at posterior extreme of first dorsal 1 ft. 10 in.; from posterior extreme of second dorsal 8½ in.; at caudal base, 6 in. Skin covered with osseous tubercles. Snout obtuse, bearing above a series of small mucous pores, extending back 11 inches from snout, over which lay the transparent jelly-like fluid they usually emit. Head; breadth over eyes, 1 ft. 5 in. Eyes, diameter 2 in., bearing no pupillary appendages, and distant from point of snout 11 in., and from temporal orifices, 3½ in. Temporal orifices, situate on a line with upper rim of eye cup, and distant from point of snout 1 ft. 3 in.; extent 1½ in.; width ¾ in. Bronchial apertures, five in number, the posterior opening situate at the base of pectorals, and distant from frontal extreme 2 ft. 4 in., is 4 in. long and situate 14 in. from the eyes. Nostrils: situate beneath and distant from snout point, 6 in.; extent, 3 in. Mouth: vertical gape, 8½ in.; horizontal gape, 12 in. Back: carinated from anterior base of first dorsal to an extent of 1 ft. 4 in. forwards. Pectorals commence immediately behind posterior branchial aperture; width at base, 9 in.; extent 1 ft. 4 in. Ventrals commence 3 ft. 6 in. from posterior base of pectorals; width at base, 6 in.; extent, 8 in. First dorsal commences 4 ft. 7 in. from snout point; width at base, 11 in.; extent from anterior base to extremity, 18 in.; from posterior base to summit, 5½ in.;

loose, flapper-like extreme of fin extends 7 in. beyond the posterior base, and lies close upon the back. Second dorsal commences 2 ft. 2 in. from posterior base of first dorsal; height at posterior base, 4 in.; length, 14 in.; width at base, 7 in.; loose flapper-like extreme extends 6½ in. beyond the posterior base, and lies close upon the back, as the first. Caudal commences 12 in. from posterior base of second dorsal; extreme span, 2 ft. 7 in.; upper lobe, extent, 23 in.; lower lobe, 16½ in. Lower lobe commences 3 in. in advance of upper; carinated at base; carinal ridge, two inches from lower surface, and four inches from the upper surface.

Fam. RAIIDÆ.

94. RAIA RADIATA, *Don.*

95. R. GRANULATA, *Gill.* M. S. This new species is given in Messrs. Goode & Bean's List of N. E. American Fishes (1879) as occurring on LaHave fishing-bank.

96. R. LÆVIS, *Mitch.* Barn-door skate. Dr. Gilpin informs us that this species occurs on the west coast; Bay of Fundy.

Fam. PETROMYZONTIDÆ.

97. PETROMYZON MARINUS, *L.* Lamprey. Not uncommon; generally found as a parasite on the gadoids.

ANNIVERSARY ADDRESS, 1879.

By Wm. Gossip, F. R. M. S., *President.*

Two years have elapsed since I had the honor of addressing the Institute on our anniversary, with reference to its proceedings and prospects. Then, in the absence of the worthy President, being next in office, I thought it right that one of our rules bearing upon this duty should be observed, lest it might be lost sight of altogether. Since that time you have done me the honor to choose me your President, and now it is more than ever a duty imposed upon me not to allow a rule deemed essential to the well-being of the Institute to remain inoperative, although what has to be said may not, on every occasion, be specially interesting, or largely instructive.

Science is ever progressive. True science is never lost. What the mind of man has once conceived and practically realized is almost always retained, and is never entirely forgotten. Indeed, the empire of science is so widely extended, and its influence so general, as to be beyond the possibility of decay or extinction. All nations interest themselves in its advancement, and by generous impulses contribute to its resources. Knowledge has wonderfully increased, and we may well be proud that our own mother land leads the van in the cause, and more than all others, has largely aided and encouraged the almost universal enlightenment.

When the world is prepared for great discoveries they are usually vouchsafed. The art of Printing, which is now so expansive, perpetuates invention; and steamships and railways, electricity and magnetism, annihilate space, and bring to a focus of general utility the scientific conceptions of every clime. Human intellect has so far mastered the arcana of nature as to be able to control, to a certain extent. some of her most subtle agencies, and make them obedient to its own guidance. With apparent facility, an electric current is conducted thousands of miles, through air and water, and causes a message to be deliver-

ed with exactness and truth in intelligible language. The same subtle fluid, by the same agency, bids fair to be an useful auxiliary of the less mighty steam-engine—a mechanical power, and a means of propulsion; and will, perhaps, in a short time, be economized to dispel the darkness of night in our large cities. The telephone enables individuals to converse, each one from his own chamber, over widely intervening spaces; and ere long sound may rival electricity in instantaneous communication. Except in imagination there is no power that thus mocks at distance. If we would find something analogous we must invade the realms of fiction. The authors of the *Arabian Nights Entertainments* do no more, who send princes and princesses through the air on enchanted horses, by the twist of a peg, thousands of miles in a moment—literally with the speed of thought; and our own immortal Shakspeare, perhaps dreaming of an ocean cable, evokes an adventurous sprite, able to "put a girdle round the earth in forty minutes." These were the wildest vagaries of imagination, which have become in the nineteenth century sober realities.

The imaginative standard of the past having thus been reduced to a fixed value, I may be permitted further to illustrate the practical necromancy of modern times.

Daguerre, in 1839, after years of experiment, at length by a wonderful but simple process, transmitted the human portrait from life to plates of silvered copper, made sensitive to solar light by the vapour of iodine. Soon thereafter, the principle thus fully developed, improvements sprang up on every hand, and the results so far are beautiful photographs, made permanent by autotype, which give the most accurate delineations of works of art as well as natural objects. It is not to be supposed that they will stop here, or that science has done with them. Genius will in time be able to fix the colours of the camera, as well as its shadows.

Again, experiments on light, following a growing knowledge of the laws by which it is governed, have produced the spectroscope, and now scientists assume, from careful analysis of the solar atmosphere, that they have a clue to ascertain the substance of the sun.

In connection with this subject, the experiments of Mr. Lockyer, a distinguished savant, and editor of *Nature*, a journal well known in the world of science, with reference to the solar and stellar spectra, are of much interest. He has started an hypothesis, and justified it by experiment—that the elements themselves, or at all events some of them, are compound bodies, and that hydrogen is the principal elementary substance represented

in these spectra. I cannot find in what Mr. Lockyer has written that he goes farther than this, if quite so far. But the *Medical Tribune* of April 15—a journal of scientific pretensions, published in New York—contains a well written article, by Dr. Wilder, its editor, based upon the Papers in the No. of *Nature* I have quoted, in which the argument of Prof. Lockyer is asserted to be, "that in hydrogen we have matter reduced to its lowest terms—*the only one element*." I do not think myself that Prof. Lockyer has made this a distinctly definite conclusion, but it affords, at all events, to the writer in the *Tribune*, an opportunity to assume for the hypothesis, or theory, of our associate, Mr. Dewar, and his friend Dr. Fraser, a like degree of credence. These gentlemen have long since announced, in their ato-magnetic theory, that all primal atoms are either hydrogen or oxygen, mineral or vegetable, which approaches the hypothesis or theory of Prof. Lockyer, as stated by the *Tribune*, but is of earlier date, and were it substantiated by experiment, would be as little objectionable. The writer in the *Tribune*, favorable to Mr. Lockyer's hypothesis as to the principle involved, objects "that as hydrogen is not a luminous substance, and, therefore, is of itself without motion, and, being molecular, must have been built up from atoms of a still more elementary character, there must be some force acting upon it to set its atoms in motion." Here again comes into play Messrs. Dewar and Fraser's plausible theory of the magnetic polarity of atoms. He quotes the suggestions of other scientists to account for this motion; also, that electricity, by inducing the primal atoms to assume polarity, may cause the first motion by means of the attraction and repulsion of the two poles, the positive and the negative; and gives a reason to show that the element denominated hydrogen, when negatively electric and uncombined, is identical with the substance known as oxygen. Thus the theory is similar to that of Prof. Lockyer, but with a difference. I do not pretend to understand the processes which have prompted these several speculations, generally alike. Neither appears to have advanced much beyond the confines of enquiry, and we may be content to await with patience their further investigation. To those interested in its progress, I would recommend a study of the articles in *Nature* of January, 1879, and to supplement them with that in the *Medical Tribune* of April 15, following. Perhaps in time the spectroscope may help us to a satisfactory solution of the difficulties.

To the spectrum and the microscope we may look for some of the most valuable discoveries ever made in the realms of science.

At the risk of being thought discursive or digressive, I beg leave to refer to an event of great interest, with which we may be all more or less familiar, which makes us better acquainted with microscopic revelations, and brings us so close to the beginning of life, that the power to produce it from lifeless elements appears to be almost within our grasp.

The English papers, by the royal mail steamship which arrived early in September, are occupied with lengthy accounts of the anniversary meeting of the British Association at Sheffield on the 20th August. These anniversaries have lost none of their interest for the British people. We learn from them the importance attached by all classes to scientific investigations. The Press uses its powerful combinations to spread abroad, with the utmost rapidity, over all the Empire, and to foreign countries, full details of the proceedings, employing for that purpose the energies which art and science have placed at its disposal. The railway and locomotive, the marine engine and screw propeller, the ocean cable and electric telegraph, all triumphs of science and genius within a century, engage in the work. Photography also, takes the portraits of the President and other scientists of the Association, and then by electro-metallurgy makes them typography, placing before us in a newspaper correct likenesses of the men who, in Great Britain, contribute to the scientific advancement of the nation. Do we desire to know the subjects which engage the minds of these men? The press communicates them in twenty-four hours after their delivery. They reach us by electric telegraph as quickly on this side of the Atlantic. In twelve days at farthest, by steam navigation. I may call all this the artistic application of Natural Science. The substance of the President's address is before me. It treats of Protoplasm. He describes "Protoplasm, or living matter, as lying at the base of all living phenomena." * * "a tangible and visible reality, which the chemist may analyse in his laboratory, the biologist scrutinize beneath his microscope and dissecting needle. All over the world, in fresh water and in salt, minute particles of protoplasm may be detected. In the famous amœba, which has arrested the attention of naturalists, almost from the commencement of microscopical observation, we have the essential characters of a cell, the morphological unit of organization, the physiological source of unicellular existence. But cells combine into organs, and organs into animals. Yet in the most complex animal the cell retains its individuality. * * * *

This, though not entirely new, is a lucid description of

great interest, and what follows ought to command earnest attention besides:—

"Examine under the microscope a drop of blood freshly taken from the human subject, or from any of the higher animals. It is seen to be composed of a multitude of red corpuscles, swimming in a nearly colourless liquid, and along with these, but in much smaller numbers, somewhat larger colourless corpuscles. The red corpuscles are modified cells, while the colourless corpuscles are cells still retaining their typical form and properties. These last are little masses of protoplasm, each enveloping a central nucleus. Watch them. They will be seen to change their shape. They will project and withdraw pseudopodia, and creep about like an amœba. But more than this, like an amœba, they will take in solid matter as nutriment. They may be fed with coloured food, which will then be seen to have accumulated in the interior of their soft transparent protoplasm; and, in some cases, the colourless blood corpuscles have actually been seen to devour their more diminutive companions the red ones."

All this is very wonderful, and to many whose opportunities of microscopic observation are rare must appear entirely new. They may have been prepared for the modified cell of the red corpuscle, but the protoplasmic—the living condition of the white—feeding as it were, upon itself, has only been revealed by the highest powers of the microscope. We have it on Supreme authority as to the animal, that "the blood is the life thereof," but whoever could have supposed that this Divine truth would be proved to the senses after this manner. I should imagine that the knowledge is of the highest importance. Our M. D.'s are called upon now to adjust the equilibrium between the red and white corpuscles—to lessen or increase the cannibal instincts of the white, and so to cleanse the impurities that interfere with a healthy circulation, and which are the fruitful generators of disease.

The instances quoted illustrate the phenomena of the protoplasmic cell, which is the basis of the physical life in animals. But there are other wonders. It is precisely the same in the vegetable kingdom. The President proceeds to give a number of examples to show that the primary cell in plants is identical with that in animals, and undistinguishable from it. "The spores which swim about in the field of the microscope, driven by vibrating cilia, and avoiding collision with obstacles in their way, behave exactly like the amœba." Dr. Fraser may tell you that this motion and careful avoidance of obstacles is due to

their magnetism and polarity. "But the most curious illustration of the identity of the elementary life in plants and animals, is found in the fact that the former as well as the latter are subject to the influence of anæsthetics. A sensitive plant confined under a bell-glass, with a sponge filled with ether, soon ceases to manifest any sensibility. Withdraw the sponge, and it will speedily recover germination. Fermentation may be arrested by the same means. Seeds of cress kept under the influence of ether for five or six days, remained quite passive. But they were only *sleeping*, and not killed. As soon as the ether was removed, germination set in at once with activity. The same thing is true of fermentation." It was stated as the results of all these investigations, "that in protoplasm we find the only form of matter in which life can manifest itself, and that though the outer conditions of life — heat, air, water, food — may be all present, protoplasm would be still needed, in order that their conditions may be utilized. It would, however, be a mistake to suppose that all protoplasm is identical. Of two particles of protoplasm, between which we may defy all the power of the microscope, all the resources of the laboratory to detect a difference, one can develop only to a jelly-fish, the other only to a man, and one conclusion alone is here possible,—that deep within them there must be a fundamental difference which thus determines their inevitable destiny, but of which we know nothing, and can assert nothing beyond the statement that it must depend upon their hidden molecular constitution."

And here I would venture a crude idea—that if protoplasm as revealed by the microscope, is really the beginning of life, its ultimate development may depend, less upon a hidden molecular constitution in the cell units, in which no differences can be discovered, than upon cell aggregation. Or, is it produced according to Dr. Fraser's theory, by the atoms assuming polarity, being vivified by magnetic action. The last would not be spontaneous generation, but something analogous. Really, all we know is, that like in the animal and vegetable proceeds from like. But it is an important admission by Dr. Allman, to which I would join the idea just expressed, "that his assertion does not in the least diminish the vast difference which separates lifeless from living matter, nor lessen the mystery of life itself. No chemist has yet built up one particle of living matter out of lifeless elements." Or, as I understand it, no chemist, or magnetist, or electrician, has yet made a *protoplasm*, or brought together atomic conditions necessary to create unicellular existence, much less to endow

"*an aggregate*" of cells with the direction of a positive animal life—a reason for which I think is satisfactorily given in the Book of Genesis, chap. 3, v. 22 to 24.

The foregoing are *a few short extracts* from the President's address, interspersed here and there with some passing observations; for I have felt, in the relation, that I may not only be too diffusive, but that I am trenching somewhat on the province of our talented associate and microscopist, Dr. Sommers. I have only further to hope that our Institute will soon possess microscopic instruments of sufficient power to enable *him* to show us all those microscopic experiments and microscopic life, the wonders of which have been for some time known to the scientists of other countries. From these anticipated resources we may, I think, reasonably expect, that in this to us new field of investigation, discoveries will be made that will prove our high estimation of this valuable branch of Natural Science, and perhaps enable us, in an hitherto untried zone of research, to contribute a little to what has been already realized.

Yet, after all the wealth of scientific discovery of our day, and our pride in it, which sometimes amounts to inflation, I think it must be conceded by sober reason that human progress, great as it is, has reached no further than the threshold of the temple of science, the golden pinnacles of which seem now and then to greet our vision high above the clouds of obscurity. The motto of its votaries must still be "Excelsior!" Still it is not as in the past ages, that speculative science, assuming the general ignorance, stands for truth, or is received without strict examination. The world has had much to unlearn of what had been for long periods received as indisputable. The earth, without further controversy, rolls round the sun, and is no longer a flat surface girdled by an unknown ocean. Even within a century revealed religion has been placed, I think, upon a surer basis by scientific interpretation. Geology, with yet much to unfold, so far shows us that the world (I say it with reverence) was not made in six natural days, although the sequence of creation corresponds more exactly with a reasonable and no doubt a more correct interpretation of the Divine record; and crude deductions with respect to the effects of the Noachian deluge, are fast giving way before investigations which, without ignoring that great event, or any of its phenomena, reasonably attribute much that was presupposed to belong to it, to other and remoter causes. These truths are intimately connected with and lie at the foundation of many of the grand discoveries of the age. Some of them are dogmas

now, and all will be so with succeeding generations. The difficulty with them is the self-sufficiency and scepticism they engender, and to restrain their assertion within the bounds of propriety. Science and religion ought to dwell in perfect harmony. True science can do no more than accommodate each to each by the operation of the laws of eternal truth. This is being done gradually but surely. If some of the most celebrated searchers into nature of our own day could wake up a century hence, they would without doubt be as much astonished at the stride of knowledge meanwhile, and the consequent disturbance of previous belief, as those would be who have lived a century before our era, could they now start into living consciousness of the past and present.

It may excite a smile that I should imagine so curious an event; but we may still consider it certain, that a comparison of notes would realize to all their minds the practical truth enunciated by one of the wisest among them, as true as when it was uttered, as to all that has been done, to wit: that we are only as children picking up pebbles from the shore, while the great ocean of truth lies unexplored before us.

But it is time that I should come nigher home. In Nova Scotia, within ten days' distance by steam of the mother country, and adjoining the great republic,—where we have unsurpassed facilities for acquiring a knowledge of and utilizing the latest scientific progress and discoveries,—it might be supposed that we would be practically acquainted with and profit by them, and with everything recognized as improvement. The necessity, however, is conceded but slowly, and we have not much to boast of in this respect. Our scientific pursuits are nearly all limited to a college curriculum,—to a course of chemistry, electricity, botany, and cognate sciences. This is doubtless an excellent preparation, but as yet, so far as we know, no further fruits have been produced. It is a college education — nothing more. There may be various reasons for this. Nova Scotia, though early settled, has never been very well known in the world, especially in the world of science. Capital and enterprise have not been largely employed to call her material resources (not to mention those which are inert) into active operation. She has looked to other means of wealth which were more readily procurable, but which, whatever they may have been, are not now steadily profitable. She is, in fact, so far as science is concerned, much behind the age. The urgency is, however, being rapidly forced upon her, that resources but partially used, or not used at all,

must soon be called into action, if we would play our part as an integral portion of British America. There is enough of talent and ability amongst ourselves to take secondary action in their development, although neither speculation nor capital at present appears very eager to make them available. It certainly does seem strange, that we cannot even point to the existence of a cotton-mill, with a chief city which is the Atlantic entrepot of a Dominion stretching from Halifax to the shores of the Pacific, possessing as we do railway communication for a long distance inland, and, as we shall do in a few years, from hence to British Columbia, to say nothing of the limitless coal and iron in Nova Scotia, and a cotton-growing country within twenty days' sail of our chief port. A reason may be found on the part of our own people in the want of capital for so expensive and important an undertaking, and ignorance of its management. But that our unsurpassed geographical position, and the acknowledged decadence of British manufactures, through rivalry of foreigners, should not have turned the attention of the cotton lords of England to Nova Scotia, from whence to supply the growing Dominion, and to carry the war into the enemy's territory, is something not easily understood. I may be pardoned this allusion. It is not so far beyond the domain of natural science, involving as it does many of its branches, that our wishes and hopes may not centre in such an enterprise.

Of our other industries connected with natural science, I will speak briefly. Coal is inexhaustible, and I hope to see the day when cotton and sugar and iron, and other manufactories at home, shall preclude the necessity of looking for a market abroad for this valuable mineral; and when our own Dominion, the western part of it especially, shall be more ready to buy from us than we to sell to them. This is the true solution of the problem of coal mining as a source of national wealth. The time will surely arrive, and we hope is not far distant, whoever may live to witness it. Strange that even now our interests should be diverse, or not to be reconciled, and that we cannot work together as an united people.

Iron is as inexhaustible as coal, and more valuable. One blast furnace is at work for the reduction of its ores, requiring scientific knowledge and practical industry and economy to sustain it, and these will no doubt multiply as markets are realized and demand increases.

The rocks of the Atlantic coast line, from Canso to Yarmouth, and for a considerable breadth inland, are prolific in gold, which,

even now, is worked profitably, and would be much more so if science and capital were largely employed in its development.

Promising indications of Copper are frequent, even within a short distance of the capital, but they have not tempted eager speculation or scientific research. Copper, which requires patient and expensive exploration, is as yet only talked about as a Provincial enterprise. The same may be said of Silver and Lead, which are believed to exist in workable quantities, only awaiting capital and skill, as employed in other countries, to make them largely profitable.

It is high time that we knew the extent of our natural resources. I would like to be able to state that an exhaustive geological survey of the Province had been made, and its mineral riches mapped with some degree of certainty. We should know by this time if they are as valuable as they have been assumed to be, or otherwise. All doubt upon this subject ought long since to have been set at rest. The geological survey of Canada, provided for by the Dominion Government, began at the wrong end.

It will be expected, I presume, that I should, before I conclude, make some reference to the work of the Institute during the past year. I shall do so as shortly as possible. I make no comparisons, and do not claim for it any great originality, or superlative merit. It is but an humble follower in the wake of more richly freighted argosies. I shall merely assert, therefore, that it has furnished a large amount of information on the geology, mineralogy, zoology, botany and meteorology of Nova Scotia, which otherwise would not have been generally known. In that branch of science first mentioned I will take the liberty to allude to the articles of the Rev. Dr. Honeyman, which of late have been directed to a correction of the geology of our own Province. On the evidence of position and palæontology, strata which previously were supposed to be widely extended, are proved not to exist, or to belong to lower formations. I recommend these papers, which will be found in our published Transactions, to the careful attention of all acquainted with the science, who take an interest, for economic purposes or otherwise, in the succession and deposition of the rocks, as a guide to the mineral resources of Nova Scotia. A careful study of them may prevent many mistakes of scientific importance. The department of geology, I regret to say, was badly represented at the Provincial exhibition; but even there was some encouragement, and those who sought might have found very fine specimens of coal from the

Little Glace Bay, Pictou, and other mines; gold specimens from Oldham and Montague, and from the latter, within a distance of eight miles from Halifax, a brick (so called) of gold, a month's work of fourteen men, valued at $7,666.92, taken from the "Rose" lode. Also sulphuret of and native copper, and galena and silver,—with some fine specimens of granite and syenite, freestone and other rocks and minerals, awaiting science, industry and capital for their complete development.

In like manner I desire to draw attention to the papers of my friend, Dr. J. Bernard Gilpin (now absent), on the Zoology of Nova Scotia. Dr. Gilpin has successively drawn upon the mammals of Nova Scotia (Indians included) for description, until he has left none remaining the history of which he has not noted. It is almost the same with the fishes that frequent or are native of our coast and inland waters. In a recent No. of the Transactions he shows us the salmon "from his first appearance as a minnow, and through all his changes, until lastly he gives us a drawing of his degeneration (degradation I should call it) in colour and leanness, and the almost grotesque changes in the jaws of the male during spawning. He is also of opinion, against preconceived belief, (in which he is supported by Mr. Wilmot, of the fish-breeding establishment at Bedford,) that all our salmon are retained during the winter in our lakes and inland waters.

J. Matthew Jones, F. L. S., formerly President of the Institute, to whom we are much indebted for papers on various subjects, has contributed, in an Appendix to the Transactions of 1879, a list of the Fishes of Nova Scotia, corrected to date, in the preparation of which he manifests great research, and acknowledges the generous assistance of his much esteemed friend, Prof. G. Brown Goode, of the Smithsonian Institute, Asst. United States Fish Commissioner. This paper will be much valued for the information given, and for future reference.

Dr. Sommers, Prof. of Microscopy, and the Rev. E. Ball, of Maccan, furnish botanical papers of merit and usefulness—the former on Nova Scotian Mosses, the last named gentleman on Aspidium Spinulosum—*Grey.* Dr. Sommers has also furnished a paper on Microscopy.

Mr. H. Louis, Assoc. Roy. School of Mines, (a recent member of our Institute,) communicates a paper on "The Analysis of a New Mineral from Blomidon." For this contribution to science, with reference to which Prof. Dana, to whom it was submitted, remarks that there is nothing like it in Mineralogy, (meaning

that it is an original discovery,) Dr. Honeyman has suggested the name of "Louisite," by which it will henceforth be known. Also, a valuable paper "On the Ankerite Veins of Londonderry, Nova Scotia," with copious analyses. This gentleman, from whose talent much was expected, on behalf of the Institute, and the country especially, has left our shores to fill a more responsible situation in England.

"The Limonite and Limestones of Pictou County," is the title of a paper bearing upon the economic mineral resources of Nova Scotia, by Edwin Gilpin, A.M., F. G. S. The processes of nature, by which these minerals were formed, are lucidly accounted for and described, and their value shown to be considerable. According to the author they appear to occupy positions similar to the marine limestones at Whitehaven, and Furness, and the Mendip Hills, in England,—and are, by some, considered to have been deposited in a similar manner to the large deposits of Limonite, the lower silurian calciferous formation in Pennsylvania. The limestones of Artzberg and the Thuringian Forest are believed to have been formed in the same way.

Mr. Dewar has a paper on his favorite subject of Ato-magnetism—which I have previously noticed in connection with the spectrum discoveries of Prof. Lockyer, and the article in the *Medical Tribune.*

Mr. Mellish, a secretary of the Institute, placed on record at the close of last session, an interesting description of fish culture in Nova Scotia, stating that a total of 4,800,000 salmon had been distributed from the hatchery of Bedford Basin during the short space of four years.

On other matters concerning the Institute and its working, I shall be very brief. We have friendly correspondence with many sister societies in various parts of the world. The Royal Microscopical Society of London, recently passed a resolution, which recognizes for your President, for the time being, the honour of appending F.R.M.S. (Fellow of the Royal Microscopical Society) to his name, of which honour, however unworthy, your humble servant has been the first recipient. This recognition of the Institute is of some value, and has been suitably acknowledged; and I hope before long we shall be able to show, by practical illustration, that it is not undeserved. We exchange our Transactions with the valuable monthly publications of the R. M. S.

Best of all, perhaps, is the statement I am able to make—that we owe no man anything.

I would fain have closed with this gratifying announcement;

but a sorrowful task still awaits me, viz., to notice that, during the past year, we have had to lament the decease of three of our most zealous and useful members, and very good friends. You will find obituary notices of them in the published Transactions. It is again a painful duty imposed upon me to mention a fourth bereavement in the death of Dr. How, Professor of Chemistry, King's College, Windsor (not latterly a member of our Institute, but a frequent contributor to its Transactions), which took place at Windsor on the 27th September last. Dr. How was an able scientist, and had made some interesting mineralogical discoveries in Nova Scotia. He filled the professorial chair with credit to himself and the University, and with much advantage to the students, by whom he will be long remembered, and his death regretted. His loss must be deeply felt by the Institution at Windsor, which he adorned by his talents and amenities; and it will not be easy to fill a chair, the duties of which require in an eminent degree high qualifications and systematic order.

I have now, amid avocations which leave me little leisure for work like this, endeavored (imperfectly enough, I know) to perform a duty prescribed by the rules of the Institute. I fear I have wearied you with an address which, like many others of the kind, on similar occasions, has not the merit of propounding startling hypotheses or original theories. It may, however, serve to show that we are in earnest, and if it has the slightest effect in stimulating pursuits and studies within our reach, it will fulfil my highest expectations. I would have liked to be able to tell you that our people take as much interest in natural science — comparatively, of course — as the people of England do in the work of the British Association, or that the knowledge of Nova Scotia we have conveyed, which is by no means unimportant, is as highly appreciated among ourselves in this our own home, as it seems to be in other countries. This desire, however, is premature, and many of us may not await the better time coming. Instead, we must, I suppose, rest content with being the pioneers of science in Nova Scotia, and leave it to future generations to enter into and profit by our gratuitous and disinterested labors.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART 2.

Dalhousie College, Oct. 8, 1879.

ANNIVERSARY MEETING.

WILLIAM GOSSIP, ESQ., *President, in the Chair.*

Inter alia.

The following Gentlemen were elected Office-bearers and Council for the ensuing year:—

President—WILLIAM GOSSIP.

Vice-Presidents — Prof. JOHN SOMMERS, M. D., Prof. GEORGE LAWSON, PH.D., LL.D.

Treasurer—W. C. SILVER.

Secretaries—REV. DR. HONEYMAN, and JOHN T. MELLISH.

Council—DR. GILPIN, HON. L. G. POWER, J. M. JONES, ROBERT MORROW, ANDREW DEWAR, AUGUSTUS ALLISON, ALEX. MCKAY, W. S. STIRLING.

On motion the PRESIDENT was requested to deliver an Address at the next meeting of the Institute.

ORDINARY MEETING, Dalhousie College, Nov. 10, 1879.

THE PRESIDENT *in the Chair.*

A larger, than usual, number of persons were present. Among them were His Honor the LIEUTENANT-GOVERNOR, MISS ARCHIBALD, and COL. STEWART, aidecamp.

The PRESIDENT delivered a lengthy and interesting Address, which will be found in the *Transactions.*

Mr. MORROW drew attention to an error in the published *Transactions* of 1878-1879. Appendix, page 94, Mr. JONES states that Mr. R. MORROW informs him that "Scomberesox Storeri"—bill fish—is seen on the coast of Cape Breton during the month of August. Mr. MORROW stated that he had seen them in Pictou Harbor.

DR. HONEYMAN, the *Secretary*, gave a popular and interesting description of the Geology of Annapolis County, especially that of the Moose River Iron

Deposits. This was the substance of a paper which will also be found in the *Transactions.*

His Honor the LIEUTENANT GOVERNOR then made some complimentary observations on the Addresses delivered, and referred to the valuable work of the Institute, as illustrated by its Volumes of Proceedings and Transactions published. By means of its publications the Institute has been instrumental in disseminating reliable information on the Natural History of Nova Scotia in all its branches. He had just been enabled to meet the demands of Kew Gardens for information regarding the Botany of the Province, by the gift of a series of Papers published in the *Transactions.*

ORDINARY MEETING, Dalhousie College, Dec. 8, 1879.
The PRESIDENT *in the Chair.*
Inter alia.

DR. J. BERNARD GILPIN made some observations on specimens of supposed rude pottery found in and around Grand Lake. The specimens belong to the Provincial Museum. Their forms are so singular as to occasion a diversity of opinion regarding their character and origin. Dr. HONEYMAN, who furnished the specimens, has no doubt whatever that they were made by man, and that they are prehistoric remains. Some of them are of regular and rather elegant shape. The basis on which they have been formed are stones—quartzite or argillite. The other material seems to have been constructed by successive layers of clay (?) so that the interior of the articles have a concentric appearance—the outside is somewhat smooth. They are somewhat firm when wet, when dry they are very fragile. When the Lake has the water at the usual height they are said to be seen lying at a depth of six feet or more. Some consider them to be concretionary, or natural forms. The stony nucleus or basis is always exposed; when the form is saucer shaped it constitutes the bottom. Their mode of occurrence and other matters will be fully investigated in the next dry and favorable season.

DR. GILPIN also exhibited a drawing of an unknown mammal. It was supposed to be an *albino* dormouse. It was found at Annapolis last summer.

DR. LAWSON gave an interesting account of his investigation of a very thick deposit of diatomaceous clay found in the Lakes of Halifax Water Works. He illustrated the character of diatom structure and mode of growth on the blackboard, and by the microscope.

He also exhibited specimens of Cotton, Rice, and Palmetto which had been brought lately from the Southern States by MR. ANDREW JACK.

It was announced that Prof. DEMILLE and W. H. NEAL had been elected members.

ORDINARY MEETING, Dalhousie College, Jan. 26, 1880.
The PRESIDENT *in the Chair.*
Inter alia.

DR. GILPIN exhibited the Cub of a Bear, which was regarded as of peculiar interest. An account of it will be found in the *Transactions.*

Prof. LAWSON was then called on by the President to read his Paper "On Native Species of Viola of Nova Scotia."

The Paper was lengthy and interesting. It was well illustrated by means of the blackboard, and numerous dried specimens of the Viola. A conversation followed the reading of the Paper.

DR. SOMMERS also gave the substance of a Paper "On Nova Scotian Fungi." This Paper was illustrated by dried specimens.

A discussion followed.

ORDINARY MEETING, Dalhousie College, Feb. 9, 1880.

The PRESIDENT *in the Chair.*

Inter alia.

The PRESIDENT alluded to the death of Prof. DEMILLE, who had recently been elected a member of the Institute. He said :—

"I deem it a duty, melancholy though it be, to announce to you that by the recent decease of PROF. DEMILLE, after a short illness, the Institute has been deprived of another of its members, one of whom it may be truly said, that his loss will be deeply felt, not only by the Institutions of learning and Science with which he was connected, but generally by the community in which he lived. It is but little to say of Prof. DEMILLE that wherever he was known he was esteemed and respected. As an author he ranked high, and his works are very popular in the neighboring Republic, where perhaps they are better known than amongst ourselves—his Rhetoric has become a text book in several universities. Although PROF. DEMILLE's more intimate connection with our Institute had been somewhat recent, I have good reason for believing that he took much interest in its proceedings, and that he attended its meetings as often as his more pressing avocations permitted; and had he been spared I have no doubt whatever that his talents would have been freely exerted in its service. As it is there is only left to us to acknowledge, with humility, an afflictive dispensation which might not be averted by human wisdom; and to add to the general expression our sympathy with his family in their bereavement."

It was resolved that this tribute to the memory of the deceased be inserted in the Records of the Institute.

DR. SOMMERS gave a minute and interesting account of the Anatomy of a Seal from the Magdalen Islands.

DR. HONEYMAN then read some remarks on the Geology of the Magdalen Islands, suggested by specimens of Rocks and Minerals presented to the Provincial Museum.

MR. FOX, who had resided on those Islands for twenty years as Collector of Customs, gave interesting information relating to the inhabitants and products.

ORDINARY MEETING, Provincial Museum, March 15, 1880.

ROBERT MORROW, ESQ., *in the Chair.*

Inter alia.

Specimens of the Corals, *primnoa reseda*, and *Paragorgea Arborea* were exhibited from the Museum collections. These had been found by fishermen in the Halibut fishery at Little Banquereau, north of Sable Island. They were regarded with peculiar interest as being Nova Scotian products.

DR. GILPIN then read a long and interesting Paper, "On the Wild Ducks of Nova Scotia."

The Paper was illustrated by the extensive and beautiful collection of Wild Ducks in the Museum.

ORDINARY MEETING, Dalhousie College, April 19, 1880.

The PRESIDENT *in the Chair.*

DR. SOMMERS read some remarks "On a new Nova Scotia Trillium."

The specimen was found by Miss Godfrey, of Clementsport, Annapolis County, near the Victoria Bridge, Bear River.

MR. MORROW then read the first part of an interesting Paper "On the Osteology of *Salmo Salar.*"

The Paper was illustrated by carefully prepared skeletons.

ORDINARY MEETING, Dalhousie College, May 10, 1880.

The PRESIDENT *in the Chair.*

Inter alia.

DR. JAMES WALKER was elected an Associate member.

MR. MORROW read the second part of his Paper "On the Osteology of the *Salmo Salar.*"

DR. HONEYMAN then read a Paper entitled "Notes on a new Geological Progress Map of Pictou County."

Adjourned until October next.

LIST OF MEMBERS.

Date of Admission.			
1873.	Jan.	11.	Akins, T. B., D. C. L., Halifax.
69.	Feb.	15.	Allison Augustus, Halifax.
77.	Dec.	10.	Bayne, Herbert E, Ph.D., Professor of Chemistry, Royal Military College, Kingston.
64.	April	3.	Bell, Joseph, High Sheriff, Halifax.
64.	Nov.	7.	Brown, C. E. Halifax.
78.	Nov.	11.	Cockburn, Col., R. A.
67.	Sept.	10.	Cogswell, A. C., D. D. S., Halifax.
72.	April	12.	Costley, John, Dep. Pro. Secretary, Halifax.
63.	May.	13.	Cramp, Rev. Dr., Wolfville.
75.	Jan.	11.	Dewar, Andrew, Architect, Halifax.
63.	Oct.	26.	DeWolfe, James R., M. D., L. R. C. S. E.
63.	Dec.	7.	Downs, Andw., Corr. Memb. Z. S., London, Halifax.
71.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
74.	April	13.	Forbes, John, Manager of Starr Works, Dartmouth.
72.	Feb.	12.	Foster, James, Barrister-at-Law, Dartmouth,
63.	Jan.	5.	Fraser, R. G., Chemist, Halifax.
73.	April	11.	Gilpin, Edwin, F. G. S., Inspector of Mines, Halifax.
60.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., Halifax
63.	Feb.	2.	Gossip, Wm, F. R. M. S., *President*, Halifax.
63.	Jan.	16.	Haliburton, R. G., Barrister-at-Law, Halifax.
78.	Dec.	9.	Harris, V. E. Rev., Land and Mines.
63.	June	17.	Hill, Hon. P. C., Barrister-at-Law, Halifax.
66.	Dec.	3.	Honeyman, Rev. David, D. C. L., *Secretary*, Professor of Geology, Dalhousie College, Halifax.
74.	Dec.	10.	Jack, Peter, Cashier of People's Bank, Halifax.
79.	Jan.	11.	James, Alex., Judge of Supreme Court, Halifax.
63.	Jan.	5.	Jones, J. M., F. L. S., Halifax.
66.	Feb.	1.	Kelly, John, Dep, Chief Com. Mines, Halifax.
77.	Nov.	19.	King, Major, R. A., Halifax.
64.	Mar.	7.	Lawson George, Ph.D., LL.D., Professor of Chemistry and Natural History, Dalhousie College, *Vice-President*, Halifax.
75.	Jan.	11.	Mellish, John T., M. A., *Secretary*, Halifax.
72.	Feb.	5.	McKay, Alex., Principal of Schools, Dartmouth.
77.	Jan.	13.	Morrow, Geoffrey, Halifax.
66.	Feb.	3.	Morrow, James B., Halifax.
72.	Feb.	13.	Morrow, Robert, Halifax.
70.	Jan.	10.	Murphy, Martin, C. E., Provincial Engineer, Halifax.

Date of Admission.			
1865.	Aug.	29.	Nova Scotia, the Rt, Rev. Hibbert Binney, *Lord Bishop of*
72.	Nov.	11.	Poole, H. S., F. G. S., Superintendent Acadian Mines, Pictou.
76.	Jan.	20.	Power, Hon. L. G., Senator.
71.	Nov.	19.	Reid, A. P., M. D., Superintendent of Lunatic Asylum, Dartmouth.
66.	Jan.	8.	Rutherford, John, M. E., Halifax.
64.	May	7.	Silver, W. C., *Treasurer*, Hollis street, Halifax.
68.	Nov.	25.	Sinclair, John A., Halifax.
80.	April	12.	Neal, W. H., Halifax.
75.	Jan.	11.	Sommers, John, M. D., Professor of Physiology and Zoology, Medical College, *Vice-President*, Halifax.
74.	April	11.	Stirling, W. Sawers, Cashier of Union Bank, Halifax.
79.	Feb.	10.	Twining, Chas. R., C. E., Halifax.
66.	Mar.	18.	Young, Sir William, Knight, Chief Justice of Nova Scotia, Halifax.
77.	Jan.	13.	McGregor, J. G., A. M. D. Sc., Bristol, England, Professor of Physics, Dalhousie College, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
77.	May	14.	Burwash, Rev. Prof., Wesleyan College, Sackville, N. B.
75.	Nov.	9.	Kennedy, Professor, Acadia College, Wolfville.
78.	Feb.	11.	Louis, Henry, Assoc. R. Sch. of Mines, London.
75.	Jan.	11.	McKay, A. H., A. M. B. Sc., Principal of Pictou Academy.
75.	Nov.	9.	McKinnon, Rev. John, P. E. Island.
65.	Dec.	8.	Morton, Rev. John, Trinidad.
76.	Mar.	13.	Patterson, Rev. George, D. D., New Glasgow.
80.	May	10.	Walker, Jas., M. D., St. John, N. B.

CORRESPONDING MEMBERS.

71.	Nov.	29.	Ball, Rev. E., Maccan.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
71.	Nov.	1.	Cope, Rev. J. C., President of the New Orleans Academy of Science.
70.	Oct.	27.	Harvey, Rev. Moses, St John's, Nfld.
71.	Nov.	1.	King, Dr. V. C., Vice-President of the New Orleans Academy of Science.
71.	Oct.	11.	Marcou, Jules, Cambridge.
71.	Jan.	10.	Matthew, G. M., St. John, N. B.
72.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., &c., London, Mineralogist to H. M. the Queen and the Baroness Burdett Coutts.
77.	May	14.	Weston, I. C., Geological Survey of Canada.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—NOVA SCOTIAN GEOLOGY—ANNAPOLIS COUNTY continued.—BY THE REV. D. HONEYMAN, D. C. L., *Curator of the Provincial Museum and Professor of Geology in Dalhousie College and University.*

(*Read Nov.* 10, 1870.)

INTRODUCTION.

ABOUT the middle of July last I resumed my investigations in the Geology of Annapolis county. My main object, however, was the investigation of the geological relations of the Iron deposits of Moose river. They have already been connected and correlated with the Iron deposits of Nictaux. Both have been assigned to the Devonian period.

I have in a preceding paper referred the Nictaux deposits to the Middle Silurian age (*Transactions, 1877-8*), and for the time in a manner separated them from the Iron deposits of Moose river. I was prepared, however, for a reunion of both. The fact that the gigantic trilobite, *Asaphus ditmarsiæ,* was found in the magnetite of Moose river had led to the belief that it too was of Middle or possible Lower Silurian age.

DIARY.

Tuesday, 15th.—On my way to Moose river I observed granites to the south of the Lawrencetown Railway station. This is almost due north of the approximate western limit of the Nictaux Iron bearing strata. From Lawrencetown onward to Annapolis the only rocks observed outcropping are granites.

I had an opportunity of observing the granites to a distance

four miles south of Annapolis Royal. Through the kindness of one of Dr. Gilpin's friends we had a delightful carriage ride into the South Mountain. Reaching, apparently, the highest elevation on turning, the panorama beheld, on the north, was enchanting and extensive. The granite is known to extend 50 miles south of Annapolis. Dr. Gilpin has observed it thus far, and he believes that it connects with the Granites of Shelburne, on the Atlantic coast. This is important testimony, in its relation to the identity and age of the Annapolis and Shelburne Granites, as well as those of Halifax and other localities on the Atlantic Coast.

I found also a kind invitation awaiting me, from the Rev. Mr. Godfrey, of Clementsport, through his brother-in-law, Dr. Gilpin, offering me the hospitalities of the "Rectory." This was found to include very efficient assistance in the prosecution of my most important investigations. I have also to acknowledge my obligations to Mr. Church, for a copy of his excellent map of Annapolis county, plain and unvarnished. This was of very great assistance in prosecuting and locating my work.

Wednesday, 16th, Dr. Gilpin took me to Moose River, by the South Mountain Road, a very rough, but admirable geological road. Here I had an opportunity of observing the transition from the Granites to the stratified rocks, containing the Moose River Iron ores. We passed from the one into the other, about Beiler's Lake (Church's Map). The transition did not appear in outcrops, but from the contour, and the change from granite boulders, *debris* and roughness, to slaty, clayey and soft roads.

There were occasional outcrops of stratified rocks seen, before reaching the "New Mines" of Moose River ("Iron quarry" of Church's Map).

At the New Mines were observed considerable excavations, all perfectly dry and fresh in appearance. Great piles of slaty material with *Magnetite*, were exposed, so as to be satisfactorily examined. Several hours were spent collecting specimens of fossils. Dr. Gilpin showed me the *situs* of the *Asaphus ditmarsiæ*, as indicated to him by the superintendent of the mines. The rock and the matrix of the *Asaphus* correspond, both being largely composed of *magnetite*.

We afterwards proceeded through the Valley of Moose River, observing numerous outcrops of rocks on the road side and in the river, and at length reached Clementsport, at the mouth of the river. I received a hearty welcome from the worthy Rector and his family. It surprised me agreeably to find, that my head quarters were beside the Iron works, and consequently convenient for work.

The same evening I went to call upon Mr. Ditmars, the collector of H. M. customs, and of geological and other interesting curiosities. As I expected of a collection, of which the *Asaphus ditmarsiæ* was once a specimen, other objects interesting to the geologist formed a part, one of these was a large piece of *quartzite*, with a singular *cruciform* and other organisms. Mr. Ditmars kindly presented this very interesting specimen to the Provincial Museum. I shall yet refer to it in the sequel.

I was then taken to see the "Ditmars Falls." Here was observed, a fine exposure of metamorphic rocks and a really picturesque water fall. When the brook is well supplied with water, they are said to be somewhat imposing.

Thursday, 17th, the morning.—Examined the ruinous Iron works and the interesting section of rocks adjoining. The date of the erection of the Furnace, as seen from the keystone of an arch, was "A. D. 1831." The most extensive and useful part of the works that survives is the great dam and viaduct.

Forenoon.—Went with Mr. Godfrey to the "Old Iron Mines," at Milner's, (Church's map), traversed the same road which Dr. Gilpin and I travelled on the day before, a length of three miles. I examined the numerous outcrops of rocks, which I had already noticed in passing. Turning to the right we travelled upwards of a mile, crossing the extension of the Iron bearing rocks of the New Mines, without observing any outcrop of rocks. Turning again to the right, we travelled the Hessian Line road about three-quarters of a mile. We then walked in a northerly direction about a quarter of a mile, and reached the Old or Milner Mine.

No rocks were observed *in situ* from the time we left the Moose river road until we came to the Mines I examined the

old trenches, which are two in number, running parallel on two *beds* of ore, twenty feet apart.

These have the same course as the trench of the New Mines, and are one or other doubtless a continuation of the Iron bearing strata of the latter. Fossils were collected, of forms similar to those of the *Asaphus ditmarsiæ strata,* and others not found there. Returning we kept on the Hessian Line road until we reached the Moose river road, by which Dr. Gilpin and I came to the New Mine. I had thus an opportunity of examining the other outcrop already referred to, also of re-examining the New Mine and of adding to my collection of fossils. I thus found the Moose river road presenting a good cross section of the greater part of the rocks of the area under examination.

Friday, 18th, Morning.—Engaged in locating on Church's map, the positions of the several outcrops examined, and in studying their relations.

Forenoon.—We went to Bear River Village, travelling the Digby Road at a distance of two and half miles, *Strata, deep* red and *soft* of considerable thickness, were observed and examined in "Deep Brook." Half a mile farther, on the left, we came to the Bear River Road, at the Temperance Hall and School House. Proceeding along this road we found an interesting outcrop of rocks; just before reaching the summit of the mountain (Purdy's) other outcrops were observed, especially after reaching the road which follows the course of Bear River on the east. Outcrops were observed occurring very frequently between the cross roads and the village. Still keeping on the east side of Bear River, a short distance above the bridge, I found and examined an interesting outcrop of rocks, on the river side. The rocks are black slate with limestones, much metamorphosed and very hard. This is particularly the case with the limestones, which are fossiliferous. I could only get fossils out of them, where they were weathered, I collected some at the southern side of the outcrop, consequently in the lower *strata.* On the Digby county side of the river, the same *strata* are seen outcropping in a shipyard where a large ship was being built. Farther up the river we crossed at the bridge at Rice's mill; here we found a splendid

outcrop of rocks, which at first sight seemed gneissoid, on closer examination they were found to be highly fossiliferous. I collected a few fossils and traced the outcrop southwards, until the rocks became obscure. Beyond, heights were observed with large granite boulders. In the village, on the Digby side, north of the bridge and below the wharves, another important outcrop of rocks was examined, on the road and river side. Returned to Clementsport by the way we came.

Saturday, 19th.—Examined an interesting outcrop of strata, at and north of the wharf, on the shore of Clementsport and opposite the Iron works: afterwards walked along the Moose river road to the New Mine, examining in succession and detail the outcrops of rocks already noticed, with a view to the proper understanding of the geology of the district.

Sabbath, 20th.—Attended service in Mr. Godfrey's churches, at Clementsport and Bear river village; went to Digby in the evening; attended services at Mr. Ambrose's.

Monday, 21st.—We travelled the road to Waldee, which branches from Moose river road about half a mile from Clementsport; observed several outcrops of rocks similar to those exposed on the Moose river road, and examined the strata exposed in a deep brook at Waldee; proceeded to the mouth of Bear river and Digby road by the old post road, on which were observed interesting outcrops of rocks. Returned to Clementsport by the Digby road.

Tuesday, 22nd—We returned to Bear river for the purpose of examining certain rocks exposed in a brook and on the river side, about half way between Bear river village and the Victoria bridge; observed strata between the cross roads already referred to (Friday, 19th), and the rocks of which we were in quest We found the rocks in the brook, somewhat obscured by *debris*, but collected fossils. On the side of the river we examined a fine clear section of the same rocks; collected fossils, and also observed the rocks underlying. We returned by the road we came.

Wednesday, 23rd.—In the morning I went to the point, east side of Clementsport, with the expectation of finding *strata* ex-

posed at low water. I passed over the beach, teeming with life, searched for *strata* among luxuriant sea vegetation, and found only a great accumulation of rock masses and boulders, from the mountains on the north side of the basin (Annapolis). Under a pouring rain I made a collection of marine *fauna*, which lay in my way. I reached the rectory after a walk of a mile, wet enough. The rain was very much desiderated by the farmers, and upon the whole a rainy day was not very objectionable to myself. I had thus leisure to make up my notes, locate my work on the map, run my lines into, and even to forecast the geological arrangements of Digby county, especially on the coast of Saint Mary's bay, to await confirmation in another season.

Thursday, 24th.—I proceeded to revise and complete the Moose River section by making probable additions, whose existence was inferred from occurrences at Bear River, *i. e.*, I expected to find the extension at Moose River of the fossiliferous rocks, found above the Bear River Bridge and Rice's Mill.

Friday, 25th.—About a mile S. E. of the New Iron Mine we found a fine exposure of the rocks sought for. From this outcrop to a sawmill on the west branch of Moose River, $1\frac{1}{4}$ miles, nothing was to be seen but the *evidence of Granite.* i e. a change of *contour*, granite *debris* and boulders. Under the guidance of Mr. Godfrey, I believe that I have examined every important exposure of rocks in the district. The whole area traversed is $7x5\frac{1}{2}$ miles$=$38 square miles. The greatest width of the strata examined seems to be from Digby to some point west of Bear River, along the line of strike of Bear River strata, being 5.5 miles. Along Bear River, the width is 4.3 miles; along Moose River and road extension, 4.3 miles (the measurements are according to Church's map).

PETRA.

1. *Granites.*—We have seen that the stratified rocks of the region are bounded on the east and south by granites. The granites are a continuation of those of Nictaux, and the same as to general character and age, i. e. in age they are Lower Cambrian with Lower Silurian alteration. Here they have not been observed in contact, or even in close proximity to the strata as at

Nictaux, consequently this element has not been available in the matter of mutual correlation.

2. *Gnessoid rocks.*—Dr. Gilpin informed me of the existence of gneissoid rocks in the Granite Mountain, south of Annapolis, not far from the point of Panorama, (Diary Tuesday). Since then he has given me specimens of the rocks referred to. They correspond with the gneissoid rocks at Nictaux and are doubtless of the same age, (Upper Cambrian). Masses and boulders of similar rocks were observed in the region of Moose River. Some of the masses looked as if they might be *in situ*, but they were evidently transported. It is possible that the rocks may intervene between the fossiliferous quartzites of the extreme south of Moose River section and the granites, without making their appearance by outcrops.

3. *Diorites.*—As at Nictaux these are of frequent occurrence. The greatest exposure of Diorite (1) is on the Digby side of the Bear River, (Victoria) Bridge. This may be regarded as the first of the Bear River section of rocks. Diorite (2) was observed on the Old Post Road near Bear River. (Diary, Monday,) Diorite (4) is near the summit of Purdy's Hill. (Diary, Tuesday,) Diorite (5) is on the Moose river road about a mile and a half from Clementsport. Diorite (6) is on the same road section about an eighth of a mile from the preceding. Diorite (7) is about a third of a mile from Diorite (6), and at the lower end of Bear River Village, (Diary, Thursday,) at a distance of about three and a half miles from Diorite (1), at Victoria bridge. It is not far below the extension of the strata of the New mines in the same locality. If this Diorite 7 were to be extended to Moose river its position in the section would not be far to the north of the New mine. If the others were in like manner to be extended, we should have Diorites occurring in the section the same number of times as in the Nictaux river and Cleveland mountain section.—*Vide Paper.*

4. *Quartzites and Sandstones.*—The Quartzite which seems to be *first* in order is exposed on the Annapolis side of Bear river, about one-eighth of a mile from Diorite [1] (Diary, 2nd Tuesday). Mr. Godfrey informed me that an attempt had been

made to improve the river road, which is certainly very steep where it passes over this quartzite and its associate rocks, but had to be abandoned on account of the hardness of the rocks. The outcrop on the river certainly indicates considerable thickness and flinty hardness. The *second* quartzite is exposed at T. Bogart's, in great masses on the east side of the road. The road makers seems to have shunned this. It is of equal hardness with the preceding. It occurs 1.1 miles from it. The *third* quartzite is at Rice's mill. This is fossiliferous (Diary, Thursday, 17th). It is more like a sandstone. It is metamorphic, but not in the same degree as the two preceding. It has cleavage but is of inferior hardness. Its extension is at Moose river, which is also fossiliferous (Diary, Thursday, 24th). This is highly metamorphic and of equal hardness with Quartzites (1 and 2).

5. *Micaceous Slate.*—A thick band of highly micaceous and black Slate succeeds the *first* diorite (3) of the Moose river road section. The outcrop of this is very striking. It looks like roofing slate and divides very regularly into rhomboidal forms. When split the surfaces are coated with scales of mica, giving an unctuous touch.

Another micaceous black slate was observed in connection with the great quartzite of Bear River.

These slates very much resemble the micaceous strata of Nictaux Falls, except in compactness. As this properly may be viewed as accidental, the resemblance may be regarded as indicating the co-temporarity of the Nictaux slates, which I was led to regard as of *age prior* to the strata with which they are associated. *Vide Paper in Transactions.*

STRATA.

Argillites.—In describing these I shall sketch the Moose River section.

1st.—We have the red and grey strata north of the wharf of Clementsport. The same appears in sections on the Digby side of Bear River, at the Victoria Bridge. This is above diorite, (1.) They are also seen in Deep Brook, at Ditmars farm, between Victoria Bridge and Clementsport. Here they extend from the post road to the beach of Annapolis basin. They

are all very red, so much so that when ground they may be used as *red ochre.* Part of the strata of light colour are said to act like soap when used in washing. The softness of the band and its position leads to the inference that it has suffered very much from denudation in previous periods as well as the present. It doubtless added its *quota* to the formation of the New Red Sandstone (Triassic). Its colour should be taken into account on speculations "On the colouring of the New Red Sandstone" of Annapolis and Kings Counties. I have already credited a part of this colouring to the *Red hematite* of Torbrook, Nictaux. The red slates of Kentville and Wolfville should not be overlooked. In the outcrop at Clementsport the red and grey argillites have interbedded quartzites and quartz veins, the latter attaining to a thickness of three inches. Following these are slates of various shades of grey and black, on them the wharf is built.

The next in order are the strata of the Iron works on the other (E.) side of the harbour. These extend as far as the Bridge according to the outcrops. They are highly metamorphic, having slaty cleavage joints. They are very hard, micaceous and crumpled. Their colours are grey and black.

Beyond the Bridge are the slaty strata of Ditmars's Falls (Diary Wednesday). On the road the outcrops of these are often bold cuttings. This is especially the case at the beginning of the road to Waldec. About a seventh of a mile beyond the Bridge a fine outcrop is seen in the river. They present a beautiful banded appearance, and are very hard. After this comes the micaceous slate, already described. Beyond these, after an obscure interval, we have the slates of the New Mines, also described. These extend to Milner's Mine, westward they outcrop on the Annapolis side of Bear River, and also on the Digby side above the Diorite. As the quartzite with fossils, at the end of the Moose River section, has been shewn to be the extension of the Fossiliferous sandstones at Rice's Mill, Bear River, we may assume that the outcrops extending between New Mines and the Quartzite are of strata, which are the extension of the fossiliferous strata between Rice's Mill and Bear River (village) Bridge. I think that I may also assume that Bogart's Quartzite (No. 2), Bear

River, extends eastward to the north of Milner's Mine, and may even be concealed in the obscure interval noticed in the Moose River section. My additional reason for supposing its existence near Milner's is, that the specimen of quartzite containing the singular forms already referred to (Diary Wednesday), as received from Mr. Ditmars, was found there. On comparing the specimen with others from Bogart's quartzite, I find that they are *identical* even in *accidental structure*, such as quartz veins. The position of this quartzite relative to the *Asaphus ditmarsiæ* strata, according to this analogy, will be about a quarter of a mile north, and therefore (geologically) considerably *lower*. Supposing the former to be of Middle Silurian, the latter may be assigned to the Lower Silurian period.

There is considerable variety in the strike and dip of the strata of the area.

The red slates in Deep Brook (Ditmars's) have a strike N. 55 E., S. 55 W., and a vertical dip.

The red and grey slates of Clementsport have a strike N.60 E., S. 60 W., and a dip 43 S.

The strata of the Iron works have a strike N. 55 E., S. 55 W., and a dip S. 51 S., also a strike N. 40 E., S. 40 W., and a dip 40 N. They seem to be folded.

The same below the Bridge of Moose River have a strike N. 45 E., S. 45 W., and a dip 48 S.

The strata in Moose River have a strike N. 60 E., S. 60 W., and a dip 65, S. 30 W.

The strike of the micaceous slates in the vicinity of Diorite (3) is N. 75 E., S. 75 W., dip 74°.

The strata of the outcrop of Purdy's Mountain (diary Friday) have a strike N. 50 E., S. 50 W., and a vertical dip.

The black fossiliferous slates of the outcrop in Bear River, above bridge, have a vertical dip, and also a dip 68, N. 30 W.

The fossiliferous sandstones at Rice's Mill, Bear River, have a strike S. 60 W., N. 60 E., and a vertical dip.

The formation of these crystalline Diorites here, as elsewhere, e. g., and East river, Pictou, and Nictaux, Annapolis, have been the cause of the prevailing metamorphism and disturbance of the

stratified rocks. Two of the Diorites present the same phenomena at their point of contact with the strata, as are found in the localities specified, coalescense as if from contact while the Diorites were in fusion. There is in fact a blending of the crystalline and uncrystalline rocks. To the same cause the peculiar condition (magnetic) of some of the bedded ores is also to be assigned.

Quartzose and Micaceous.—This seems to indicate in a peculiar manner the origin of the strata as well as their relation to the associated rocks. The material has such a granitic character as to impress the conviction that it has been derived from the associated granite. It thus teaches the same lesson as the *condition* of the uncrystalline rocks in contact with granites at Nictaux.—*Vide Paper on Nictaux, Transactions, 1877-8.*

Red and gray argillites of the Moose river section, Bear river and Deep brook, seem to throw light on the geological relations of similar strata at Wolfville and Kentville. Here we have palæontological aid, which was much desiderated, especially at Wolfville (*Paper in Transactions, 1878-9.*)

FAUNA.

Coelenterata.

Corals.

1. *Stenopora.*
2. *Petraia sp?*

Annuloida.

3. *Crinoidea.*

Annulosa.

4. *Cornulites flexuosus.*
5. *Beyrichia 2 sp.*

Trilobita.

6. *Asaphus ditmarsiæ.*
7. *Dalmanites gilpini.*
8. *Calymene?*

Mollusca.

Brachiopoda.

9. *Strophomena alternata.*
10. *Athyris sps.*

11. *Spirifera sps.*
Lamelli branchiata.
12. *Modiolopsis sp ?*
Gasteropoda.
13. *Pleurotomaria ?*
14. *Maclurea ?*
Heteropoda.
15. *Bellerophon trilobatus.*
Pteropoda.
16. *Theca sp.*
17. *Tentaculites sp.*
Cephalopoda.
18. *Orthoceras ?*
Incertæ sedes.
19. *Arthrostauros godfreyi.*

Notes on *Fauna.*

2. *Petraia sp?* This coral is small, having a diameter 10 m. m. It seems to be a cast of the top of the calyx. The *septa* are numerous, being distinct around a fourth of the circumference, where the number is twelve, making a total of 48. A *carapace* valve of a *Beyrichia* covers the half of it.

5. *Beyrichia 2 sps.* These are numerous. We have *Carapace* valves of at least four distinct forms, representing, possibly, *two species.* At Nictaux two indistinct valves were found which were supposed to resemble *Beyrichia kloedeni.*

Here they are decidedly different and undetermined.

6. *Asaphus ditmarsiæ.*—This trilobite, which I described and named in the last year's *Transactions,* is one of those giant forms which appear and culminate in the Lower Silurian, and survive to the middle or intermediate Silurian period. Its bedding here is *magnetyte.*

7. *Dalmanites gilpini* is also from the mines, of this I have only a *glabella.* This however is in good preservation. It is broken off at the *occipital* furrow. From this to the front, the length is 19 m. m. This is equal to the width of the *frontal* lobe. The width of the *anterior* lobes is 16 m. m. of the *median* 14 m.

m., of the *posterior* 12 m. m. There is a deep *fossette* on the back part of the frontal lobe, a little above the anterior furrow. It is *papillose* or coarsely granular except in the space between the lateral furrows, there being only two tubercules from the curve of the fossette to the occiput. All the species that have been found in the "Upper Arisaig series" with the exception of *Dalmania logani* occur in B' or Clinton, none of them are papillose. Regarding the species as new, I have named it *Dalmanites gilpini.*

9. *Strophomena alternata* does not occur in our "Upper Arisaig series" but it is of frequent occurrence in the "Wentworth series" of the Cobequid mountains, which I have correlated with the Hudson river or Cincinnati period (Lower Silurian).

10. *Athyris* of several species are found in the forms of casts. This *genus* prevails in the lowest part of the "Upper Arisaig series," being generally associated with corals, which were referred to the genus *Petraia* by Mr. Salter. The *Athyris* then disappears to reappear in great force in the Lower Carboniferous Limestone.

11. *Spirifera* are abundant here as at Nictaux, especially in the Iron mines. It is the prevalence of *Spirifera* that makes me hesitate in placing the *Asaphus strata* lower than the middle Silurian. In the "Upper Arisaig series" Spirifera are most numerous in the Middle Silurian division.

14. *Maclurea, s. p.*—The form which I referred to the genus Maclurea occurs in the specimen of quartzite referred to in my Diary (Tuesday, 15th), associated with the *Cruciform* organism. It is a cast of the top of the shell or *whorl.* The width of the cast is 2.7 x 2 inches, its depth .7 inches.

15. *Bellerophon trilobatus.* Several specimens of this *Heteropod* were found at the mines. It differs from the *Bellerophon trilobatus* of Arisaig in the form of its middle lobe. It is not so rounded, being rather acute, so that it may be regarded as an older variety. *Bellerophon trilobatus* is not found in the Middle Silurian of the "Upper Arisaig series." Its first appearance is in its *crinoid* strata, at the base of C, the Upper Silurian.

16. *Theca, s p.* is very much like *Theca triangularis* of the

Upper Silurian. This is its first occurrence in Nova Scotia, away from Arisaig. It appears to be a *prior* occurrence.

17. *Tentaculites, s. p.*—This is a small *species* like that of B, "Upper Arisaig," Middle Silurian.

19. *Arthrostauros godfreyi.*—This is the *Cruciform organism*, associated with *Maclurea.* Its obvious form is that of a Roman cross, not altogether straight in the body, the lower part of it being bent to the left. It is jointed. The number of joints is eleven. The ninth has two branches or arms of equal length proceeding from it in opposite directions. The right one has a tendency upward, not being altogether at right angles to the straight part of the stem. The joints are compressed bead shaped, and are generally half an inch in diameter. The only form that I have seen figured, which has any thing in common with it, is the *Arthroclema pulchella*, Billings. Of this the joints are differently shaped, and the branches are more numerous. While *Clema* signifying *a twig* is sufficently appropriate as representing the shape of the latter, *Stauros* is more appropriate to the specimen before us.

The *Maclurea and Arthroclema* are Lower Silurian forms in Canada.

Localities.

The localities in the Moose and Bear rivers area, having fossils are: 1st the New Mines. 2nd the Old Mines. 3rd Beaver river above the bridge and at Rice's mill. 4th the continuation of Rice's mill strata, at Moose river. 5th Bear's river midway between the Village bridge and Victoria bridge.

Inferences.

We are thus led to the conclusions—

1. That the *magnetyte* strata of Moose River are not newer than the Middle Silurian Period.

2. That the Quartzites at Bogart's and their eastern extension are of Trenton, if not Calciferous, age.

I have already on lithological considerations, regarded the great quartzites of Gaspereaux River, Kings County, and their associated argillites as possibly of Lower Silurian age.—*Transactions 1878-9.*

Palæontological evidence was in the case of these quartzites and argillites much desiderated. The *Maclurea* and *Arthrostauros* of Moose River may be considered, in a measure, as supplying the *desideratum*.

Certain quartzites and argillites, in Cleveland Mountain, Nictaux, may be included in the same category, as well as other quartzites at Beaver River, *e. g.*, at the joint locality No. 5.

CÆTERA.

I searched for Triassic strata resting on the red and grey strata, as at Wolfville and Kentville, but did not find any. The only formation met with was post-pliocene drift and clays. Red and tough clays were found on the shore and river banks. On the sides of Moose River were observed sections of lofty red banks of drift. In these were abundance of boulders from the North Mountain. Boulders of Basalt and Amygdaloid were found scattered everywhere. Great granite masses were also observed transported from the granite region on the east or south.

Cambrian gneissoid boulders and masses were also found as far north as Clementsport. One mass on the road from Moose River to the Milner Mine, (Diary *Thursday)*, was so large as to seem *in situ*. The original rocks were not found. They may lie concealed on the borders of the granite region, as this was their position at Nictaux.

At Lawrenctown we have observed that the South mountain presents a granite front. Behind this the mountain continues to rise, including the extension of the Nictaux stratified rocks and diorites, wedged between the Lawrencetown and New Albany granite.—(Vide previous paper, Trans. 1877-8.)

Succeeding are the granite heights of Paradise, from which proceeds its river to join the Annapolis river. As Annapolis is approached the South mountain with its granite, and the North mountain with its traps, converge; the valley narrows and the Annapolis river widens into the French and Annapolis Basins. Between these lies Annapolis Royal on a peninsula.

Its Triassic strata, if such there be, lie concealed ; no outcrop appearing all around to give evidence of their existence. The Archean granite and Triassic Traps are only evident. The two

periods, separated by time of duration inconceivable are thus in space, brought into close contiguity.

From Annapolis the Basin begins to widen, and the mountains to separate. The route is continued along the south side of the Basin over the border skirting the granite rising ground and mountains on the south, which at length abruptly terminate and retreat, to make room for the area of stratified and igneous rocks which has been examined.

Approaching Clementsport, the flat border is widened and becomes on the east side of the port, an area with farms of considerable extent adorned with large and elegant houses

On the back of this area the ground rises—the soft, red, grey and black slaty strata, as I have observed, being succeeded by the hard strata of the Iron Works. The Episcopal Church is seen crowning the height, while the Rectory is seen peeping out among the beautiful trees on the less elevated ground below.

From the Rectory front through an opening among the acacias, pines and fruit trees, the prospect is beautiful. The port and mouth of Moose River, with its village, wharves and wood crowned heights, is seen extending into the basin, whose wide expanse is bounded on the north by the North Mountain. Over the woody point on the east side of the river mouth Digby town is well seen, and its wonderful mountain gap (Gut) which opens into the Bay of Fundy. The inmates of the Rectory, with the aid of a neat little *Dollond* spy-glass, are able to render the view still more interesting by bringing the distant mountains nearer, by seeing steam boats and ships on their way to and from Annapolis, and by bringing Digby, its churches, residences and inhabitants within sight of the observer.

Going from Clementsport to Bear River the flat and fertile border is still farther traversed.

At Mr. Ray's farm it has its greatest width, his elegant residence seeming at a great distance. The width here is little short of a mile. A great beauty is the abundance of cherry trees with a good crop of cherries. This is the introduction to a celebrated product of this part of Annapolis and Digby Counties.

The story of the early settlement of the district is interesting

A few Refugees—four in number—had all the flat country between Clementsport, as a grant, and part of the hilly region extending to the distance of a mile from the shore. The back hills were afterwards granted to disbanded German soldiers. Hence we have the names Waldec and Hessian Line in the mountains. It appears that a feeling somewhat akin to Jew-Samaritan prevailed between the two classes of settlers.

On the road to Bear river village which turns to the south of the main road, an ascent is made into the mountain. Near the first summit the outcropping rocks diorite, quartzite and slate indicate the origin, age and constitution of this part of the mountain, and its continuation. From this elevation and various parts of the mountain road, (Waldec) which runs on the tract and ridge of the mountains. A panorama to the north, north-east and north-west of Annapolis, the Basin, North mountain, Digby, its gut and neck with St. Mary's bay is truly enchanting. The mountains of course have their vallies, the rocks outcropping in the brooks, in these, account for their existence.

The road on the east side of Bear river, half way between the village and mouth of the river, presents a lovely view. The river somewhat broad winds beautifully on either side, it is mountainous, the heights over the quartzite with its fossiliferous argillite rise abruptly, covered with forest, the long Victoria bridge is seen spanning the river near its mouth, beyond which is a part of Annapolis basin; North mountain closes the view.

Bounding the south side of the district is a long valley, behind which rises parallel after parallel of mountains, which seem to be granitic from the all prevailing spread of granite masses and boulders, without any other rock appearing, or are seen to be granite from the prevalence of solid granite.

At the Bear River end of the great valley, Clements Vale, and the bounding mountain parallel, is situate Bear River village. This village is remarkably beautiful and picturesque. It is set on either side of the beautiful river, among hills of considerable eminence. It belongs to two counties—Annapolis and Digby. It has its wharves, drawbridge and shipyard, and is the seat of considerable trade. A large and beautiful barque, just launched,

lay at one of the wharves alongside of piles of lumber. This was associated with other vessels. In a shipyard above the bridge another barque was on the stocks. This shipyard is a place of Geological interest. The ship stands on one of the outcrops of fosiliferous rocks already referred to. Its numerous churches and elegant houses are worthy of notice. A great charm is the prevalence of ancient and noble oaks, and great, beautiful and productive cherry orchards. The last was an important element in the pleasure of our visit. It was cherry time—there was bustle in cherry picking for export, and local enjoyment. The following Sunday was "Cherry Sunday." Visitors from distant towns and villages were expected to aid the robins, who were remarkably numerous and busy in enjoying and disposing of the cherries. Bear River is evidently a paradise for robin.

Art. II.—Geological Waifs from the Magdalen Islands.—By Rev. D. Honeyman, D. C. L.

These islands are situate in the Gulf of St. Lawrence, between long. 61° 23′ and long. 62°, and lat. 47° 13′ and lat. 47° 52′.

They have a trend N. 45 E., S. 45 W, corresponding with that of Nova Scotia and Cape Breton.

Amherst islands, Grindstone island, Entry island ând Allright island, the south-west islands of the group, are all peculiarly elevated according to the Admiralty charts.

In Logan's Geological Map of Canada the formation of the island is indicated as Lower Carboniferous.

My attention has been specially directed to the geology of the Magdalen islands, by specimens brought from time to time to the Provincial Museum.

1.—I received, three or four years ago, two pretty large specimens of Manganese ore, Pyrolusite, from Mr. William Johnstone, of Halifax. These are identical in character with our specimens from the Lower Carboniferous Limestone of Hants, N. S., Teny Cape, N. S., and North River, Colchester, &c. From these I was led to infer the existence of Lower Carboniferous Limestones in the Magdalen islands, having Manganese.

2.—Specimens of Gypsum were subsequently received from Mr. John Boak, of Halifax. These are of character and quality identical with the Nova Scotia Lower Carboniferous Gypsums.

3.—Lately other specimens were received from Mr. John Tucker, of San Francisco. There are, first, a specimen of coarse agate, with cavities containing quartz crystals. Second, three beautiful jasper specimens, blood red, green and yellow.

These are all from Grindstone island; and are evidently trap minerals.

From these observations we are led to infer that the Magdalen islands are of some geological importance, and its minerals of possible economic value.

Their geology appears to indicate the existence of an enormous submerged area of Carboniferous strata lying between Gaspe, Canada, and Port au Port, of Newfoundland, extending to Cape Breton, Nova Scotia and New Brunswick.

On a part of this Prince Edward Island's Triassic Sandstones seem to rest.

Mr. Fox, the collector of customs, who has been a resident of the island for twenty years, informs us that the elevation of Amherst island, Grindstone island and Entry island is from five hundred to six hundred feet; that trap is prevalent, on these islands, that one of the specimens is undoubtedly derived from this.

The first looks like a specimen found in situ; the others may be transported boulders.

The Jasper pebbles are identical with some that I received about six years ago, with beautiful agate pebbles, from Gaspe bay, which lies to the N. E. of Grindstone island.

The Gaspe pebbles are thus referred to in Logan's Geology of Canada, 1863, page 404.

"Associated with these are others (pebbles) of agate and of red, yellow and green Jaspers, often brilliant in colour, which have probably been derived from the Conglomerates of the Gaspe Sandstones. These Jaspers and agates are known among collectors as 'Gaspe pebbles.'" Of course the conglomerates in this case can only be regarded as the secondary source of the 'Gaspe

pebbles,' just as the Carboniferous Conglomerates of the Cobequid mountains in Nova Scotia are the obvious secondary source of many of the rounded boulders and pebbles of Syenite, Diorite and Porphyries which are found in our post pliocene drift.

The Jasper pebbles are supposed to come from the post-pliocene, so that they may have come from Gaspe.

Gypsum was once an article of export to Canada. It is not now exported; Nova Scotian Gypsum is preferred.

Art. III.—On the Semi-Annual Migration of Sea Fowl in Nova Scotia.—By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(Read March 15, 1880.)

In this paper I wish to call the attention of the Institute to that part of the great semi-annual migration of sea fowl which passes the whole eastern coast of North America, belonging to the coasts of Nova Scotia; of the separate genera and species of which it is composed; of the monthly periods of their passing; and of the modifications both in time, in frequency and in species, which advancing civilization has produced. From the earliest writers and voyagers, not only along the New England coasts, but also of our own Province, we notice mention of these migrations, and are amazed by their numbers, darkening the air and blackening the shores along which they passed. With no enemy save those natural ones, which the economy of nature always provides, they passed north and south without fear or molestation. For the last three hundred years, an advancing population at almost every point on their passage, from Labrador to Florida, has thinned their numbers, altered their route, and perhaps, in one or two instances, changed their route entirely, or destroyed a species. The small part which the shores of our Province of Nova Scotia take in these migrations, or indeed the still smaller part that has come beneath my own personal observation, aided by one or two friends, will be the subject of this paper.

List of water fowl and sea fowl personally noticed in Nova

Scotia. Nomenclature of Dr. Coues, *Key.* North American Birds :—

Branta	luecopsis,	Barnacle goose.
Branta	bernicla,	Brant.
Branta	canadensis,	Wild goose.
Anas	boschas,	Mallard.
Anas	obscura,	Black duck.
Dafila	acuta,	Pin tail.
Mareca	americana,	Widgeon.
Querquedula	netion,	English teal.
Querquedula	carolinensis,	Green-winged teal.
Querquedula	discors,	Blue-winged teal.
Spatula	clypeata,	Shoveller.
Aix	sponsa,	Wood duck.
Fuligula	marila,	Scaup.
Fuligula	affinis,	Little Scaup.
Fuligula	collaris,	Ring-neck duck.
Fuligula	valisneria,	Canvas back.
Buchephala	clangula,	Golden-eye.
Buchephala	islandica,	Barrow's Golden-eye.
Buchephala	albeola,	Buffle-head.
Harelda	glacialis,	Old wife.
Camtolæmus	labradoreus,	Pied duck.
Histrionicus	torquatus,	Harliquin.
Somateria	mollissima,	Eider.
Somateria	spectabilis,	King Eider.
Oedemia	americana,	Scoter.
Oedemia	fusca,	White-wing.
Oedemia	perspiliata,	Surf duck.

Of this list of fourteen genera and twenty-seven species we find that nine genera, with the exception of the genus Aix, and one species obscura of the genus Anas, are more or less rare. Appearing in some years tolerably numerous and then for years not seen. I have never seen myself or heard from others of any Swans being seen in our Province. Of Geese, I had sent me from Sable Island, in the year 1870, an immature specimen which I put down to Leucopsis, especially from the dark line

running through the eyes and on the nape of the neck, the dark wing coverts, and black bill and feet. In 1874, I saw two specimens of the same shot on Halifax common, and in the collection of my friend, Mr. Downs, who considered them the young of the snow goose. With every respect for one who may be called the best field naturalist in the Dominion, I cannot reconcile the black bill and legs with Wilson's description of the pale lake or reddish purple of the bills and feet of the young snow geese shot on the Delaware river, and must maintain my opinion. These are the only specimens I have seen.

Of the Canada goose, his migrations may be said to be regular in the Spring. From after the middle of March to about the middle of April, numerous flocks pass over the land, going north-eastwards, and scattered parties, of half a dozen or more, are found feeding along the shores of the tide ponds and salt estuaries of the Bay of Fundy, the Atlantic coasts, and especially the shores of Cape Breton. Should heavy north-easters prevail these flights are driven down in numbers to the land, and thus every few years wild geese are plentiful in Halifax market during April. I have noted 10th April, 1879, one being shot at Digby, near the Bay of Fundy. The Brants also pass about the same time of Spring, but are less noticed, except during a long period of foggy weather, when they seem bewildered, and cover the flats in hundreds, and are easily shot. The autumn migration of the geese and brants is less noticed. I have no notes of their alighting, but several of the peculiar note of the wild goose heard in October, November, and indeed midwinter. During one Spring, about 1870, the brants remained about Digby, N. S., till the middle of May, becoming very fat though arriving very lean. That these geese, as well as the snow goose, once bred in numbers on the salt marshes of Annapolis County, and that their habits have been altered by advancing population, is well proved by old writers. The early French writers notice the abundance of "outards," both white and grey, that bred on the Port Royal marshes, the white being no doubt the snow goose; and those bred from wild eggs, and carried to France as a royal present, still existed in their descendants, which thronged by hundreds,

in Buffon's time, the royal waters of Versailles, as the "A Canadensis." There are people still alive who recollect that the Brants bred in abundance in St. Mary's Bay when they were children. I scarcely need say that none are found breeding there now, or scarcely alighting, except in some years. This power in the individual bird of prolonging its existence by altering its breeding grounds must perpetuate its race, whilst other races having attachments stronger to one place have died out, and are still, during our own time, diminishing.

Of the next family of true duck or fresh water fowl, with the exception of the black or blue wing duck, and wood duck, which, curiously enough, are resident, consisting of the mallard, pintail, widgeon, the teals and shovellers, they may be said to be rare; never to abound in market, to appear during fall and winter, and chiefly to be found in private collections or in note books of naturalists. Thus I note, "Mallard, young male, no white collar, shot Sept., 1875, Cole Harbor, near Halifax—J. M. Jones." Pintails rather more numerous. Halifax Museum, Young collections,—Mr. Downs and Mr. Egan, males full plumage. Of the teals, blue winged, male full plumage, shot Jan'y, 1880, Halifax; green winged teal, Halifax market, 12 Dec., 1871; male, full plumage, myself; English teal (Q. netion), very rare, mounted by Mr. Downs, with American, to show the difference of species; widgeon, female, full plumage, Jan., 1880, Halifax, Mr. Egan; and a shoveller, exceedingly rare, shot at Digby by my son; and, shot April, 1879, Halifax, male in full plumage. Mr. Egan. From these extracts we find this family rare in individuals, and occurring during winter sometimes, and then in full plumage. Whilst those birds thus make our Province a casual visiting place, it is singular that the blue-winged duck, a true type of the fresh water duck, with its long and low bill, slender neck, legs brought forward, a poor diver but good walker, so closely allied to these genera in all these respects, should be a resident, in company with the wood duck, nearly as closely allied also, yet it is so. Down in the salt marshes bordering the river mouths, just above tide way, we find him nesting in May. In August, the mower with his scythe cuts the young brood scarce-

ly able to fly. At the same time others are nesting along the rush fringed sides of our inland lakes, and the young are protected by their mother seeking their food in the shallow rapids. In 1854, I found them nesting on the low banks of the salt lake or lagoon which makes the centre of Sable Island, some eighty miles seaward from the Province. The nests were very inartificial, more like the circular folding or twisting of the long grass by the duck's body and legs with a few scattered feathers. The eggs were a light bluish green and about ten in number. Whilst in June I saw the mother duck leading her young flock on the lake, I have seen others sitting patiently during the last of July on, perhaps, a second or third robbed nest. If undisturbed they would doubtless remain on these salt marshes till the ice drove them out. Disturbed by sportsmen, they seek the lakes. In September they are found feeding upon the blueberries covering our barrens, and as winter advances, and the frost drives them, they return to the salt marshes, and at last, in deep winter, to the bays of the ocean; thus returning to marine molluscs that furnished their first food. In deep winter he is found nestling beneath the snow, waiting for the ebb tide to bare the rocks from which, being no diver, he collects his scanty supplies of frozen molluscs. On Sable Island he remains as long as the salt lake keeps open from the ice, but returns in the early Spring. This duck may be called both resident and abundant in the Province. Although often and long ago described, yet I cannot forbear describing again a male in full plumage shot at Digby, N.S., 9th February, 1880:—

"In colour, top of head obscure line running down back of neck; shoulders, upper back axillaries and wing coverts blackish, but as almost every feather had its edges brown, the general appearance was brownish. On the top of the head the brown appears in lines, on shoulders and other parts as scales, the lower back and rump black, the tail sooty black, but each feather emanginated. The primaries sooty black, the secondaries having a speculum of blue with purple reflections, bordered above with velvet black and edged with greyish white: the tertiaries having the outside edges velvet black. Beneath the colour and shading of feathers like the upper parts, but lighter. Edge of shoulder spotted black and brown. The upper part of inside wing pure white, but shading off to bluish ash, darker towards the extremities; beneath tail, dark ash. Returning to the head, there is an obscure line passing from behind eye

to back of head. All below the eye, the cheeks, the chin, throat and sides of neck, for about four inches, may be called very pale fawn, as a back ground to numerous dark pencilled dots or lines. In the full nuptial plumage of the male, the border between this lighter neck and the deep brown of the breast becomes very distinct, indeed, with his pouting cheeks, swelling neck and tumid feathers, he looks as if he had an ashey white neck and head. The female and young are less distinctly marked. The bill is long and low, the frontal feathers coming down in a peak, the side feathers in a semi-circle. The colour of the bill is greenish horn with the tips black and a subcircular nail on each tip. The lammella very fine in both mandibles; the nostrils high up. A line runs along the upper mandible from rictus to tip, and a second line above this, from the tip, passes it. The legs are a dusky orange, with a red wash; the webs scarcely black; the soles dusky. The tarsi and toes are uninterruptedly scutellated on their front; on other parts, obscurely reticulated.

Total length, 2 feet.
Length of spread wings, 3 feet 3-10 inch.
" of upper mandible, 2½ inch.
" of tarsus, 2 inch.
" of longest toe, 2½ inch.
Irides, dark brown.
Tail feathers, 16 —

In some young birds shot 1st August, 1880, and still in fine feather, the plumage was much darker than adult, and less diversified by fawn or brownish edges to the feather. The other resident duck we have cannot be called abundant. Unlike the last sombre colored but still very beautiful bird, he is adorned by the most beautiful metalic tints of the tropics, and seems an alien upon our frozen streams. Of the wood ducks breeding here, I have had several specimens of the young, shot August 17th, 1877, near Annapolis Royal, in their first plumage, and not having the white forked collar of the adult. The Indians all maintain he is found mid-winter about the rapids and low falls between our inland lakes, which never freeze. This has been confirmed by sportsmen, and also lumberers, who camp all winter beside these streams, yet he seems out of place, and I fancy not abundant or long to remain. I have never seen him in winter myself. Our next group of ducks, consisting of the Scaups. the Ringnecks, Canvasbacks, the Goldeneyes and Buffleheads, stand immediate between the freshwater and the sea ducks. They are at home equally in lake and ocean. They are expert divers but bad walkers, having the leg thrown far back. Their

bills have become short and high, their forms more robust, necks shorter, and bodies losing the long oval form of the typical black duck, and becoming round and humped, and the hind toe lobulated. With the exception of the Canvasback, of which I have noted two specimens, and the Ringneck, (F. collaris), the only specimens of which I have noted were kept alive by Mr. Downs, and I think were originally young taken in the eastern part of the Province, the other members of this group may be called common. The scaups, bluebills or blackheads, as they are variously called, come into the Bay of Fundy about the last of October and leave us in April. The specimens noted by me were all marilla, but a mounted specimen in Halifax Museum of affinis shows both forms to be present with us. The next group, which Dr. Baird has justly united in his new genus, Buçephala, the goldeneye and buffleheads, are common, coming to the Bay of Fundy in October and leaving us in April. Though not so numerous as the common goldeneye, yet in some seasons the Iceland species may be said to be plenty, in others rare. After a careful study of many specimens of each, both males and females and immature birds, I have been enabled to generalise that both males have the violet wash in the green of the head, though Richardson makes it typical in the Iceland species; that both females have the snuff yellow wash upon their heads, which my friend Mr. Boardman makes typical in the female Iceland; that there is a tendency in both females for the brown to run to dingy duck green on their heads, and that the party coloured bills in both females are very few in comparison with leaden coloured ones; that it appears in some young males, and their fewness can only be accounted for by considering them transient and becoming effaced by adult age. The anatomical difference in the trachea of the males, (paper read March 12, 1878,) must prove them distinct species. Before we notice the next group of purely pelagic duck, which never seek fresh water, are still shorter and rounder in figure, legs further behind, much better divers, but scarcely walkers at all, we may note that both these groups of pure freshwater fowl, and the intermediate one of partly fresh and sea fowl, although they do no doubt perform the semi-an-

nual migration along our coasts, yet are never seen performing it, or are a scene in the landscape. We find them feeding in our inland lakes or dallying about our salt-tide marshes, and we scarcely know if they are successive flights or the same flocks. We have only what may be called stragglers from the eastern wing of the great migration, which doubtless makes the great freshwater streams and lakes their turnpikes further inland, and our rarer species must be the involuntary stragglers that are pressed towards the sea coast by westerly gales. The third group of migratory sea fowl are purely pelagic and procure their living by diving. They never affect the freshwaters or are seen inland. They include the heralds, the scoters, the eiders, the rather scarce harlequin, and the almost extinct Labrador pied duck. Of this last species Mr. Downs secured about thirty years ago the three or four last specimens known in the Province. One of them is in the collection of Col. Drummond in Scotland; Mr. Boardman has one, and the third must be the specimen obtained by Mr. Brewster, of Cambridge, Mass., lately, and marked from Nova Scotia. Wilson, in 1818, speaks of examining many specimens in the market of Philadelphia, and in 1830 it was well known by the gunners of Newport, R. I., who called it the skunk duck, from its black and white colors. It is probable this species is becoming extinct, as the causes of its scarcity appear now permanent. Of the king duck, (S. spectabilis), I have only noted three specimens, in market, Halifax, Dec. 11, 1871, one of which is now in the collection of Mr. Boardman, St. Stephen's, and though a male in full nuptial plumage, has the peculiarity of having no frontal plates to the bill. This species is so eminently pelagic in our latitudes as never to seek our shores unless driven in by gales of wind. The common eider or sea duck, as it is here called, is plenty, especially in the form of the female and immature birds. I note that Mr. Egan informed me he once watched a pair nesting near Halifax, N. S., but this is the only instance that has come beneath my notice. With the exception of the harlequin, which are rare, the old wives, the three species of scoters, and the common eider ducks, make up our true migratory sea fowl.

I note a surf scoter (O perspitiata), a young male, as early as August 8, 1879, shot at Digby, evidently a young bird of the year's; a very early date. From this date to November, the surf scoter, the velvet scoter (O fusca) and yellow-billed or bottle-nosed scoter (O americana) come flying in the Bay of Fundy in small flocks, and remain all winter. I have never noticed the black scoter (O nigra), though given in Wilson, Nuttall and Baird. The American student must feel obliged to Dr. Coues for returning these species to one genus, and in studying their common habits, forms, and especially common colour, and protuberance at base of bills, wonder how any naturalist, either cabinet or field, could ever have divided them into two or three genera. The old wife, or old squaw, comes to us about the same dates with these, and is often seen in company, either flying or pressed to a lee shore by heavy weather, sitting upon the waters. The eiders come in rather later, but are sometimes numerous in Spring. Whilst the semi-annual Fall migration of these sea duck are scarcely noticed, except by naturalists and gunners, whilst in the pursuit of food or warmer seas, they seem leisurely to fill our shores and pass our rocky promontries, whilst some remain all winter, seemingly, as we are unable to say they may not be successive flocks in passing, the returning Spring seems to awake new thoughts and new feelings in all these migratory fowl. Sometimes in February, oftener during March, the garrots cease their perpetual diving; the males, with tumid heads and throats, and more brilliant and purple green reflections, swim in restless circles around the sombre female which, half buried in water, with extended neck and flattened body, evade his approach. The glass-like water is thrown into mimic surf by their play. Or the male throws his purple head far backward till it rests upon his back, and a short shrill cry comes across the water from his upturned bill. The old wives, a little seaward, are playing the same antics, and a prolonged note, much like a distant bell-buoy, directs you to the male, with creamy and pouty head, long snowy axillaries falling athwart a velvet black back, and long tail carried straight and high, is circling around his greyish mates. The coloured gentry in these magic reels, the scoters,

with lake or orange bill, and scarlet leg gleaming from the velvet darkness of their suits, play this game so stoutly that among the hardy fishermen they have gained the name of courting coots. Thus it appears that pairing takes place long before the instinct of migration moves the whole mass northwards. This migration is strongest during April, and lasts into the middle of May. Beginning far away southward and west, Florida perchance, it strikes our westernmost point, Westport, Brier Island, passes along Yarmouth, Shelburne, Lunenburg, strikes Sambro, the western head of Halifax harbour, and pours its tide all along the eastern passages, Canseau, and finally leaves our shores at the north-eastern cape of Cape Breton. For all day long and for many days in fine weather, flock after flock of heralds, scoters, and eider ducks, every few minutes come scattering along, flying low upon the ocean, but rising when passing a rocky point. From many a rocky ledge, or boat anchored to a buoy, comes flash after flash, followed by the roar of a duck gun, and three or four victims falling headlong into the sea. The heralds and eiders seem to perform their flight first, followed by the yellow billed scoters and the velvet ducks, called May whitewing, because they prolonged their migration until May. Thus, as I have said before, these flights are obvious and make a pretty scene in the landscape, whilst the geese, flying high in the air, escape our notice, and the true ducks and their allies disappear as it were unnoticed, but no doubt performing the like migrations on inland routes and fresh water streams. Some fifty years ago, it was my delight as a boy to watch this feathery stream as it flowed by the headlands of Newport, R. I. A respectable and grave set of men called gunners locally, but termed fowlers in law, and having common rights under the "Fowlers and Fishers' Act," pursued this sport with great ardour. They had unwritten but severely respected law, of every boat's exact position on the water, and every man's right of fire on land. They owned a weather stained old grey granite hut called the fish house, with its boats chained all round it, and further away towards the sea, a stone duck fort, a circular wall of dry stone, titanic, and looking so like what I have in after years seen the

Micmacs dwelling in, on the rough shore of the Bay of Fundy. They shot from long ducking guns, with buccaneer stocks, (the front of stock very convex,) flint locks, and every man measuring his charge in his palm, from a long curved powder horn; and yet they were good shots; and on the evening of a soft April day, the fog clinging around Brenton's reef, it was a pleasant sight to see them slowly following homeward, with their big spaniels and lusty Newfoundlands, two or three horse loads full of game, each horse piled high with a feathery pyramid of black and grey, gleaming with scarlet bits of leg or bill. It was rare then to see four wheeled waggons; a manlier generation used horseback, sometimes the old two wheeled chaise. These men knew the Labrador duck, now nearly extinct, and taught me to identify the Huron scoter, for which I vainly sought in Buonaparte's catalogue, N. Y. Lyceum, and which in after years was first scientifically described by Herbert in American wild sports, allowed by Baird, but denied by Coues. Whether this sport is still carried on, by breech-loaders and patent shell, I know not, but must return to our own part of the stream, and the modification time and civilization has wrought in it, not referring again to the ancient voyagers. The opinion of those most interested in it steadily maintain its rapid decrease, or at all events its alteration of route. Wilson speaks of birds now almost extinct as found in the markets. M. Audubon, speaking of the sea ducks in the Bay of Fundy, says "that by the 10th August they (eiders and scoters) are so naked of feathers and destitute of quills as to be unable to fly, and are clubbed by the Indians, sometimes to the number of two hundred and fifty in one foray, being unpaired birds remaining from the previous winter." With a fair knowledge of the southern coasts of the Bay of Fundy, and of the Indians about them, I can say these are the stories of former days, and that no such hunts are made now. Even in Labrador their numbers are declining. In the official reports of the Dominion of Canada for 1878, it is stated that the Mingan Indians, during the summer of that year, were reduced to comparative starvation from the absence of feathered game on the sea coasts. We may take the fate of a kindred species, the great

auk, now universally admitted to be extinct, as a forewarning of the fate of others. If we admit, as indeed every one must, that Joseph Josselyn Gent, when writing of "N. England's varieties," 1672, was describing under the name of wobble, the great auk, then used as food and common in New England in June, "an ill-shaped bird having no long feathers on their pinions, which is the reason they cannot fly, not much unlike the penguin," the complete extinction of this bird shows what the presence of man can do. A bird organized for existence in temperate zones is pushed backwards to arctic lands, and those unable to adapt their organization to its new habitat perish. It is singular that the species now supposed to be becoming extinct, the Labrador pied duck, differs from all its co-genera in having a membranous bill, and is allied (Coues) to a soft-billed species in New Zealand in this respect. May we not look to this feature among the causes of its inability to maintain that position which other species around it seem able to do. There is a growing tendency in the guillimots, the puffins, and razor-bills, to become scarce about the shores of the Province, and they are less easily obtained by collectors than formerly. The family of gulls and terns, with the sheldrakes, both mergansers and goosanders, including the hooded, breed here; all the species of sheldrakes, and many of the gulls, and none of them diminishing. Yet in early autumn the numbers of gulls which arrive show that we owe their presence to migration. I had scarcely noted, Tusket, Bay of Fundy, Sept., 1879, a laughing gull (L. atricilla) for the first time, before a letter reached me from my friend Mr. Boardman, St. Stephen's, saying it appeared on the St. Croix with other southern species about the same time. Of very rare species that have reached us may be mentioned the tropic bird, the frigate pelican and the purple gallinule, from the south, and the pomerine jagger from the north, and all after very heavy storms; the jagger after the one predicted by Saxby, Oct., 1869, and the gallinule Feb., 1870, a few days after the hurricane in which it was supposed the "City of Boston" was lost, and which the transport "Orontes" barely survived.

I have thus in this paper made a study of that portion of

these semi-migrations that touched the shores of Nova Scotia, endeavored to show the different families of sea and fresh water fowl which compose it, their various routes, and the causes that produce this variety. Some passing over the land, aerial, scarcely noticed save by the fowler or naturalist, others taking the inland water courses, and those which visit us being almost involuntary stragglers from this great western flow. Others again making the sea their pathway, and whose numbers make them common in our markets and observed by all. I have only stated what came personally to my notice or from a few friends, thinking that the narrowness of the range might be made up by the more exactness of the matter, and that perhaps others on other parts of the route may, or perhaps are now doing the same, and thus a complete account of the entire migration from personal facts be obtained. Whoever studies it is now aware he is studying a feathery stream that no longer overflows its banks, but is ever growing narrower and narrower, species dropping out, individuals diminishing, its route altering, perhaps lengthening. It is beyond doubt that that amazing feathery stream, that darkened the air, blackened the coasts it alighted upon, that had streamed on for ages, indifferent to the arrows of the thinly scattered red man, made its breeding quarters far to the southward of their present home. It is certain the snow and the Canadian goose once visited Nova Scotia, and the extinct auk spent his June in Connecticut. These, perhaps, are the most arctic species now, and we have a right to infer that the less arctic ones followed their habits. The very presence of man, with his boats and ships, has done much towards this; but the alteration of their food from the ocean, caused also by his presence, his works, his wharves and docks, his pollutions, have driven away their food fish, and made them seek it in northern climes.

By whatever means, however, this feathery stream has been diminished, altered or shortened, it leaves us some speculations of the past and for the future. Are those arctic forms now breeding at Hudson's Bay the same as once bred in sunny Connecticut; have they changed in three hundred years, or are we

wrong in asserting that an especial form is necessary for every zone, and that one form would not be sufficient for both places; or may it not have been that the great auk, with a form according to every naturalist of the purest arctic, flourished better in these warm seas, with this form, and owes his extinction to being pushed to where it was not adapted for existence.

ON A CUB FOUND IN A BEAR'S DEN, JAN. 12, 1880.—BY DR. J. BERNARD GILPIN.

ON the 12th January, 1880, Stephen Bradford, an Indian, hunting moose in the County of Digby, Nova Scotia, discovered a bear's den,—seeing the dark skin of the bear beneath the roots of an overturned tree, covered by its mantle of snow. His gun being foul, he exploded many caps, and succeeded in arousing the bear from her hibernation. Before he could discharge the gun, she left her den, and he then tracked her through the forest in the snow for a mile and a half, when she denned again. He returned to camp, cleaned his gun, and returning shot her, for she proved a she bear, in her temporary den. Missing his coat, he returned to the first den, where he recollected throwing it off, and there found a cub dead and frozen. This cub he took to my son, who was in camp at the time, and who sent it to me. Its weight was eleven ounces. It measured, when stretched out, from tip of nose to end of hind toe, between ten and eleven inches. It was covered by very fine close hair, black upon the back and head but bluish slate towards the belly and inside of limbs. The ears were naked; the eyes closed; the tongue exposed, and the jaws slightly open. There were no teeth, but the claws were much developed, and the tail long. From the umbilicus being entirely healed, and no cicatrix upon it, I judged it to be about ten days old. After a careful and measured life-size sketch, it was placed in alcohol. Though we gain nothing new by the possession of this most rare specimen, yet we verify personal observation, and by date, statements which have come down to us since the days of Pallas, and repeated by Richardson, Godman, and Audubon. Allowing the

cub to have been ten or twelve days old when taken, from reasons I have before stated, it puts its birth about the first of January. Our snows rarely fall to any depth before the middle of November, and our bears usually seek their dens about that period for hibernation. The male bear is easily satisfied; behind the root of an upturned tree, a mass of tangled wood, or a hollow cliff in a rock serves him, and the snows soon cover him in his rugged sleep. Not so the female, if parturient. She selects the most obscure and hidden places, lining them oftentimes with layers of spruce fir branches. It is an unquestioned maxim with Indians, that no one has ever taken a she bear with young. This is both owing to the obscurity of her hiding place, and the asserted fact that if disturbed she will always abort. My son in hunting some years ago, came upon many spruce firs with their lower branches torn off and strewed about the snow. His Indian told him it was the work of a she bear lining her den. Hard by they found a crevice in a ridge of rock, which, after ascertaining it had no occupant, he entered, crawling upon hands and feet, with his Indian holding his leg. The interior was a comfortable apartment in which he could sit upright, floored by spruce boughs, and which no tired hunter would refuse as a resting place. But it is not usual to find so comfortable quarters as these. Richardson quoting from Pennant, and Godwin, both attest to the truth of our Indians' assertions regarding the deep privacy of the female in denning. The former saying, in very severe winters many bears migrate south, but no females found amongst them; and the latter asserting that out of many hundreds of males only two females were found, and those not with young. The hard and early winter had prevented the males from obtaining that condition of fat necessary for hibernation and therefore they became what our Indians call wandering bears, never denning. Instinct compelling the female to do so, as well as her being always in the proper condition, when the male is wasted by the September rut. A party with whom I was hunting in 1841, met and killed one of these wandering bears on the first of March. Our Indians also corroborate the assertions of the older naturalists, that though the bear comes

out of winter quarters very fat, it all wastes in a few days. As to the degree of hibernation attained to, Stephen Bradford's narrative is verified by other Indians, and by observation of tame bears. In captivity, especially if well fed and housed, some never hibernate, but sleep much more during the winter. Others you may force into hibernation by want of food, and confining them in a dark cellar. They have been noticed in coming out of their houses into an atmosphere nearly at zero, to be covered by a thick mist of condensed invisible sweat; this is the vapour hanging over their dens in the forest, and conducting the Indian to them. They are never entirely unconscious, being poked by a stick they will growl but relapse immediately again, and it requires much poking to arouse them, as Stephen Bradford's bad powder and dirty gun did in his narrative. Having thus, as one may say, re-verified by personal observation and modern research, what are the recorded facts of the older naturalists as well as the traditions of our Indians, who have never read a book or heard of a naturalist, we may pass to those considerations which the finding of this most rare specimen has drawn our attention to, as regards its condition both within the womb and its nutrition after birth.

That so highly organized an animal as a bear should be able to retain not only his vitality but his animal heat, and his muscular strength for the space of four months, without any food whatever, is sufficiently wonderful, knowing as we do, that in this time, if there be no supply there is no waste, save perhaps of animal heat. But when we consider the female, we find there is waste and no supply. The material for a second life, and its growth, must be taken from an accumulated fund. Taking the middle of September as the time of conception of the individual before us, and allowing she went into winter quarters about the middle of November, she then carried within her a fœtus of two months old. This fœtus she sustained, and eliminated substance for its growth for six weeks, with no exterior resources, and in a profound torpor. This torpor spreads over all organs of the body, save those of the womb. About the 1st of January, as most certainly is proved by the conditions of

the cub, it must have been born. An atmosphere, saved only by the animal heat of the mother from that without the den, often approaching zero, and a torpid mother, awaits this blind born, feeble offspring. As no personal observation can ever assist us, we may only conjecture that some instinct leads it to the mamma where, like certain marsupials, it retains a firm hold upon the nipple; and now a change comes over the still torpid parent,—the blood that thus far carried nutrition to the fœtus must, as it were, change its base.—the circulation of the uterus shrinks and becomes obliterated, whilst that of the mamma must correspondently increase and allow the lacteal glands to secrete milk. And all this performed with no assistance without, but from sources accumulated nearly two months ago. To suppose the parent is roused during parturition scarcely accords with the analogy to the facts which we do know, that is, her torpor during lactition. Besides, modern science has caused, by the use of esthetics, the whole phenomena of birth to be performed without the knowledge of the parent; and, moreover, the care during lactition, which we know is performed during torpor, is more wonderful. The most wonderful fact is, that no food is taken by the parent during both operations. Dating the birth at the first of January, three and a half long dark months must this torpid mother secrete milk before she emerge into light or procure food for herself. The appearance of the cub at ten days old, its leanness, its weight (eleven ounces), the parent sometimes weighing five hundred pounds, attests that the amount of uterine nourishment it had then received was of the smallest quantity. It was scarcely the size of a pup, one say of six or seven the litter of a bitch weighing thirty or forty pounds. That after birth it receives but little food, and passes the most of its life in semitorpor, and scarcely grows until the parent emerges, we can only prove by their extreme smallness when found in early Spring. Unfortunately I have no dates to those I have seen at that age, or to a pair of young Polar bears I once saw, in whose instance the retreat must have been doubled in length and severity by the Arctic latitude and ice formed den. We may here remark, that in our bear hibernation destroyed all maternal instinct;

she fled from her cub; it seems probable no maternal duties had bound it to her. Had Stephen Bradford, with his dirty gun, met her in May, he would have been only too happy to have escaped with his life instead of going to camp with her skin.

In its production of young so comparatively small, and in its privacy during parturition, our bear has an affinity to the opossum, our sole North American marsupial, but without the pouch; and from these facts, as well as its hibernation, and its capacity of sustaining life either as a vegetarian or a carnivora, may justly be considered in its Polar or fishing variety one of the first mammals that occupied this continent on rising from its glacial submergence. The Polar variety, but few shades above the walrus, might easily have sustained life for the few short summer months on fish and seals, ere yet the emergence of rock peaks, or swampy terraces; and when a tardy vegetation was clothing these plateaux, and before the herbiferous races appeared, his descendants straying landward thrived upon this vegetable diet, till these races appearing after their natural food had grown for them, allowed him again to become a carnivora. In this struggle of fish, vegetable and flesh life, his prolonged torpidity, perhaps at first much more prolonged in arctic regions, and destined as he advanced to warmer climates to cease, must have been of wonderful use in his struggle for existence.—*Communicated by the Author, Jan. 26, 1880.*

Art. V.—Notes on the Anatomy of a Seal from Magdalen Islands.—By J. Sommers, M. D.

(Read Feb. 9, 1880.)

In bringing to your notice the following points on the anatomy of a seal, I take occasion to express my sincere thanks to the gentleman through whose kindness I have become indebted for the opportunity to conduct an interesting investigation.

The Seal was sent from Magdalen Islands by J. B. F. Painchaud, Esq., to Robt. Morrow, Esq., who conjointly with myself made the dissection. I wish also in this place, and feel that I carry the members of the Institute with me, to express the feelings of regard that I entertain for the spirit which actuated our

friend Mr. Painchaud, in that he had voluntarily undertaken trouble to aid us in the promotion of the objects for which our Institute has been established. Could we infuse the same spirit into the minds of many friends less remote from us, whose opportunities are probably not less than his, our Transactions would before long, supply to investigators all material knowledge required for acquaintance with the extent of our natural productions.

It is right also that I should make explanation here of what the subjoined notes will render apparent, viz: that our study of the Seal was far less minute and less perfect than it might have been. When it arrived in July, decomposition had set in, the heat of the weather at that time increased the process, which went on with great rapidity, notwithstanding it had been carefully injected by Mr. Skelly, the Janitor of the Medical College, who was careful also to keep it surrounded with disinfectants, yet the changes were not checked to any extent. The above circumstances necessitated a speedy dissection, and although the vessels were well filled with injected matter and under other conditions could have been easily followed out, we were compelled to confine our work to the study of our subject, more from a zoological than from an anatomical stand point.

The following are the notes taken July the 2nd, 1879, and subsequently on days when the dissection was carried on—the subject, a young specimen of Phoca Grœnlandica, supposed age, third or fourth month, length from muzzle to tip of tail three feet, weight eighty pounds, the cuticle having peeled in many places a description of the pelage was not admissable, colour of hair was a dirty yellowish white, the skin viewed as a whole presenting where the cuticle remained, the dark markings or spots commonly observed on seal skins from Newfoundland and Labrador, the anterior and posterior extremities had each five digits, the nails on the anterior fingers were strongly developed, those on the posterior not so large.

The animal had been caught in a net and despatched by a blow on the skull which had fractured the bones, general shape of head broad oval, length from muzzle to occiput, ten inches,

eyes fine dark prominent, with a strong nictitating membrane, which in the dead animal could be made to cover two-thirds of the globe, nostrils closed by valves or folds of mucous membrane, external ear without appendages, the meatus opening by an oval aperture upon the skin of the head in the position usual in mammalia, the meatus was beset with soft bristles, depth of canal of external ear, i. e. from meatus to tympanum one and one half inches, the body on the removal of the integument presented a well nourished appearance, the sternum was prolonged upwards to the top of the larynx by a cartilaginous extension, this measured three and one half inches above the clavicles, and gave origin in its whole length to portions of both pectoral muscles, these muscles arose as in the human subject from the sternum and ribs in front, but the great pectoral was continued downward to the point of the ziphoid cartilage, their insertions the same as in man, viz: to the clavicle humerus and scapula, the positions of other thoracic muscles are so similar to the corresponding parts in human anatomy I deem it to be unnecessary to proceed with their description.

The development of these muscles in the seal corresponds more to the same in birds than in land mammals, the shoulder muscles are also correspondingly developed, the trapezius very thick, deltoid and biceps short, thick, and strongly attached to the bones, these points in the myology of the seal can be seen only on dissection, they are covered by the general integument nearly down to the wrist joint, as however the integument is loose the bones short and articulated at opposing angles, there is much freedom of movement in the anterior limbs.

The modification of the bones at the extremities, furnishes a most striking peculiarity in the anatomy of the seal; in the superior, the scapula is broad, rounded at the edge, bearing some resemblance to the same bone in man, the fossæ for the supra and infra spinati muscles are deep, the under surface of the bones are deeply concave for the lodgement of the large sub-scapulars, the humerus very short and thick, the ulna and radius also short, but the olecranon process of the ulna is much prolonged to afford attachment for the powerful extensors of the arm, the metacarpal

and phalangeal bones are developed out of proportion to the bones of the forearm, taken together they have a much greater length, the flexors and extensors of the wrist, &c., are short and thick, the tendons are long and well developed.

The inferior extremities of the seal are also confined in the general integument, the bones being shortened and otherwise modified as in the anterior extremities, yet every bone is present as in man, the gluteal muscles are short and well developed, but it is evident from dissection that the other muscles of the hind limbs in the seal are not so well developed as the corresponding organs in the anterior members, the articulation of the femoral bones, and the insertion of their muscles are such that the inferior extremities are twisted so that the tibial bones are external to the fibulæ, owing to this the palmar surfaces of the feet become opposed to each other in a position similar to that which can be produced in the hands of man by the partial rotation of the radius upon the ulna.

The phalangeal bones of the feet are longer than those of the forelimb, the claws are not so large, the tegumentary covering broader and looser allowing great freedom of movement in these parts which are readily observed to be specially adapted for progression in the water, while comparatively useless for the same purpose on land. The tibiæ and fibulæ were free.

Opening the thorax, the viscera were examined; larynx and trachea same as in other animals, the rings of the latter being, however, complete; right lung, upper lobe distinct; middle and lower imperfectly divided or marked off from each other; left lung distinctly two-lobed; weight of lungs and heart, $1\frac{1}{2}$ lbs.; heart large, notched at the apex, denoting imperfectly the septum between the ventricles, four-chambered; the foramen ovale open, Eustachian valve not more marked than in the heart of adult human subjects: ductus arteriosus not present. The aorta gave off separate subclavian and carotid arteries for either side. The anatomy of the vascular system in other respects differs not from that of man.

Of the abdominal viscera, the stomach was large, having the bagpipe shape of the organ in carnivora, being also simple; it

measured when distended about 14 inches in length, by about $5\frac{1}{2}$ in width. There is a permanent constriction at the junction of the middle with the pyloric third due to the muscular fibres dividing the organ into two imperfect cavities. The intestines measured in length 42 feet, 3 inches; diameter, about $\frac{3}{4}$ of an inch. Mucous membrane of both stomach and intestines, desquamating, was not examined microscopically. There were no valvulæ in the intestines. The stomach, &c., contained shrimps, partly digested herrings and bones. The liver had so far decomposed, its dissection or examination was rendered impracticable, no gall bladder was observed, although some attention was given to its discovery. The spleen and pancreas were not noticed; the kidneys were moderate in size; the urinary bladder small, oval shaped; ureters much larger, "thrice," than in man; urethra measured from neck of bladder to tip of penis about thirty inches. The animal was a young male; the generative organs small. The penis was contained in a sheath or pouch of the integument of the abdomen, this sheath extends from the vent upwards towards the umbillicus, enclosing the organ so completely that a superficial glance would lead to the supposition of its being entirely absent. The penis is provided with a long bone, situated or in connection with the corpora cavernosa; the diameter in this young animal being about that of an ordinary lead pencil. The testicles are within the abdominal cavity. The spermatic cords and vessels on either side pass through a very long abdominal canal, with internal and external rings, as in man. They pass up the abdominal wall to join the root of the penis. The testicles contained no spermatozoa. The penis could be made to protrude from its abdominal sheath.

Any remarks which I am inclined to make in reference to the seal will refer only to the organs of progression, and taking the evidence afforded by their anatomical structure, it is easy to draw the following conclusion, viz.: so far as the two pairs are concerned, their uses are entirely different. The shortness and restricted movements of the anterior extremities renders them but of little moment in swimming. The great osseous and mus-

cular development of these organs, along with the strength of the claws, renders them adaptable for climbing. The seal raises its own weight out of the water by means of its fore limbs; it uses them also, when on land, as a means of progression. While moving in the water they are at rest, held tightly against the body, upon the ice or solid surface the palmar surfaces of the anterior flippers are underneath. The tips of the fingers approach from side to side, and the olecrenon processes point outward. The posterior limbs under like conditions are not brought into use, they trail out behind, their edges resting upon the support. They may be said to be practically useless as organs of locomotion on land, but their shape and structure eminently fits them for swimming. They present broad, flattened surfaces to the water, the regular contraction of the extensor muscles of the leg and foot causes the latter to flatten and spread; by contraction and relaxation of the hip and thigh muscles, the thighs are drawn towards the abdomen and then suddenly projected from it; the broad feet striking the water, drives the animal's body forward by a succession of jumps. The seal moving in the water does not swim smoothly like a fish; on the contrary, the propulsion is due to successive arching and straightening movements of the lower portion of the body, resembling very much the movements of a shrimp propelling itself by its tail. We must not forget that the hind limbs of the seal are somewhat in the condition of those of a human being, whose legs being enclosed in a bag, with his feet free, the only movement he could accomplish would be that of leaping, by drawing his thighs towards the abdomen, throwing his body forward from the soles of his feet. The hummocky motion of the seal on land described by many, is due to their being used in such a way as described above; but as the soles of their feet cannot be brought upon the ground or ice. the animal rests upon his knees or heels, and attempts to use them as the moving point. The natural condition of the organ renders them facile in threading water, but makes them awkward and inefficient for like purposes on land or ice.

Of the whole family, the sea lions are the only ones that can

rest with the palmar surfaces of their extremities upon the land, because there is greater freedom of leg and arm than in our seals. They move more freely and with greater rapidity when on land, nevertheless their movements are on the whole very similar to those of our own species.

NOTE—The tentorium cerebellum partly of bone as in cat, falx cerebri at its junction with tentorium also formed of bone.

ART. VI. — TUBES IN THE FEET OF THE MOOSE. — BY R. MORROW.

Read May 10th, 1880.

IN April, 1877, I read to you some "Notes on the Caribou," (see vol. 4, *Transactions N. S. I. N. S.*, page 281, *et seq.*,) in which I drew your attention to the tubes in the feet of the moose. I shot last December an old cow moose, in the hind feet of which the tubes were fully developed, but differed from those in the hind feet of the bull described by me (see page 292, *ibid*,) in being more perfect in shape, closely resembling the tubes in the hind feet of the old doe caribou, that is, being much narrower and more perfectly defined in their mouths, and of nearly equal diameter to their inferior extremities, also being very strongly marked, as in the caribou, by the coarse, bristly tufts of hair which issue from their mouths. The inferior extremities of the tubes are attached, as in the caribou, by strong fascia to the superior surface of the skin of the web, or soles of the feet.

In the fore feet the tubes were nearly obliterated, existing only as a slight depression in the skin, about one inch in length, the tube proper being so reduced as scarcely to be perceptible; this depression, lying between the phalanges, is attached as in the hind feet, by fascia to the sole, but the fascia extends to the middle of the depression, marking what was originally the lower extremity of the tubes, and it is therefore of greater length than that in the hind feet. There were no bristly tufts marking the tubes in the fore feet of this cow moose, as are in the fore feet of the doe caribou.

ART. VII.—NOTES ON THE BONES OF SALMO SALAR SPECIMEN FROM LABRADOR. BY R. MORROW.

Read April 19th and May 10th, 1880.

Spinous Rays, &c. BEGINNING at the junction of the dorsal ridge with the occiput there is a bony process in advance of the first spinous ray; flattened vertically, somewhat broader above, but stouter below, it is attached to the dorsal region by stout fibrous tissue, its ventral extremity at about midway to the 1st spinous ray, and it is the first interspinous bone;* it is entirely different in form, from its representative in the ubiquitous perch, and were it cut out and looked at merely as a fish bone, few would recognize it as an interspinous bone, from the description of such bones as usually given.

2 & 3. The 2nd & 3rd spinous rays have each a short interspinous bone attached to their extremities, overlapping posteriorly.

4. This ray is without the intersp. bone.†

5. The 5th spinous ray has its interspinous bone overlapping in front, and rather longer than those belonging to 2 & 3.

6—15. All these sp. rays have their intersp. bones overlapping anteriorly, but the 15th spinous ray curves posteriorly rather more than Nos. 12, 13 & 14, and at the 15th sp. ray there is an extra interspinous bone $\frac{2}{14}$ (making 2 bones, $\frac{1}{14}\,\frac{2}{14}$) which does not reach, but its end is opposite the front of the 15th spinous ray, distant about one-quarter of an inch from it; it does not rise so high in the dorsal region as the other interspinous bones, say $\frac{1}{4}$ of an inch less than $\frac{1}{14}$ ($\frac{2}{14}$ lies immediately behind $\frac{1}{14}$, from which it is distant about $\frac{1}{8}$ an inch); $\frac{1}{14}$ and the preceding intersp. bones are nearly equidistant from each other; $\frac{2}{14}$ is very nearly a straight bone, tapering slightly from its dorsal to its ventral extremity. The dorsal ends of the 14 interspinous bones have somewhat broad heads‡ for the attachment of the muscular tissue, and all are curved anteriorly.

16. This spinous ray is without an intersp. bone, but the 4th intersp. fin bone of the dorsal is slightly in front of it.

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*In younger specimens this 1st intersp. bone has almost always its ventral extremity lying between the superior extremities of the 1st spinous ray; as this ray becomes more solid, the intersp. bone seems to be pushed out.

†In a fish from Cape Breton the 4th has an interspinous bone, but the 5th is without.

‡More perceptible in smaller specimens.

16 & 17. Between the points of these spinous rays* is the 5th intersp. fin bone, and at the 17th begins the shortening or hollow in the sp. rays for the insertion of the dorsal fin.
17 & 18. Between 17 and 18 is the 6th intersp. fin bone.
19. Opposite the point of 19, perhaps slightly in front, is the 7th intersp. fin bone.
19 & 20. Between 19 and 20 is the 8th intersp. fin bone.
21. Nearly opposite the point of 21, slightly in advance of it, is the 9th intersp. fin bone.
22. Nearly opposite the point of 22, perhaps a little anterior, is the 10th intersp. fin bone.
22 & 23. Between these, slightly in front of 23, is the 11th.
23 & 24. Between these, slightly in front of 24, is the 12th.
24. Opposite 24 is the 13th intersp. fin bone.
24 & 25. Between these, slightly in front of 25, is the 14th.
26.† Slightly in front of 26 is the 15th intersp. fin bone; at the posterior junction of these intersp. fin bones with the fin rays, and attached to the prolongation of the 15th intersp. fin bone from its lower extremity, the fibrous tissue descending and attached to *26, 27, 28, 29, 30*—the 26th, 27th, 28, 29th and 30th spinous rays is rather stronger than that which is attached to the other sp. rays. The height of the intersp. column from the centre of the vertebræ; at right angles to the junction of the fin rays, is at the anterior face of the dorsal fin $3\frac{1}{2}$ inches; at the posterior face, $3\frac{1}{4}$ inches; length of dorsal from anterior to posterior edge is $3\frac{3}{4}$ inches, and, including the prolongation of the 15th intersp. fin bone, $4\frac{1}{4}$ inches.
29-42. From, and including 29 to 42, the superior caudal spinous rays are wider at their dorsal ends than are the other dorsal sp. rays; from 26 to 42, the height of the dorsal sp. rays is nearly
42–53. equal, and from 42 to 53 they rapidly decrease in length, and their dorsal ends are comparatively narrow.
54–55. At the point of this sp. ray begins the upper or dorsal portion of the caudal fin (the ventral portion begins also at the 54th). The 54th and 55th sp. rays are anchylosed at their

* The shortening of the spinous rays for the insertion of the dorsal I do not find in some specimens of the Cape Breton Salmon.
† The hollow for the dorsal is here completed and the spinous rays begin to rise.

bases, and towards the anterior dorsal edge of 55 the bony plate nearly touches 54.

55, 56, 57. Are anchylosed, and on 57 is the last dorsal spinous ray proper; but in addition, and anchylosed with the three spinous rays above named, are two or three other rays, which may be termed representative. I cannot decide their number they are so confused. These three rays unite with a short bone, which is attached to the 57th sp. ray, and lies nearly parallel with the 57th and 58th spinous centra. The 57th spinous centrum begins to rise, that is, to curve upwards towards the dorsal edge of the caudal fin, and with the 58th and 59th centra and the lower Y shaped bone between the forks of which the notochord passes, forms an angle with the anterior part of the spinal column of about 35 degrees.

Saddle bones. Beginning at the posterior edge of the 56th centrum are a pair of bones of irregular and peculiar shape, one on each side of the spine. They are attached to the dorsal edge of the spine, and are joined by strong cartilage in this specimen, by their ventral anterior edges to the posterior edge of the 56th centrum, covering the ventral end of the 57th sp. ray, anteriorly about $\frac{1}{8}$ of an inch, nearly at the middle of its height; their dorsal edges pass over the 57th sp. ray, posteriorly they cover and attach the three rays which do not reach the spinous centra, 58 and 59. These bones, which, for lack of a better name, I will call *saddle* bones, attach the three rays which I have already spoken of as representative rays, by cartilaginous union to the spinal column. When these bones are in their proper position the spinous rays appear to be all perfect; but the 58th and 59th centra have no dorsal spinous rays. Close to the posterior end of these saddle bones, protecting the no'ochord, and lying under the anterior edge of the short caudal fin ray, No. 10, reaching nearly to the dorsal edge of the spinous centra, is on each side a short irregularly shaped bone, about $\frac{5}{8}$ of an inch in length, somewhat pointed at either end. On the outer sides of the posterior extremities of these two short bones, the points of the short caudal rays next to the first perfect dorsal caudal fin-rays, right and left side, have a slight attachment.

The next bone we meet has its anterior edge divided, that is, it is Y shaped, so as to admit between its points the passage of the notochord, together with its protecting tissues, and the posterior edges of the saddle bones nearly touch the points of this bone. Its posterior or outer edge is united, but in a younger specimen would probably be found as two separate bones. This bone is of the same shape, but about half the size of the Y shaped bone to be noticed in the ventral aspect of the spinal column.

I have thus reached the dorsal extremity of the spinal column, not including the spongy centrum to which the fourth or upper hypural bone is attached, and which makes, if included, 60 vertebræ.

Spinal Column, Ventral aspect—Ribs.

C 1 & 2. There are no ribs on the 1st and 2nd centra, these being so situate as not to require them, but there are their representatives in the shape of processes.

1st pair on 3rd. From the 3rd centrum, at its lower edge spring the first pair of ribs, which are somewhat crooked in shape, and naturally shorter than the others. They are comparatively round bones, and in length from articulation to point 2· inches.

C. 4. The second pair of ribs, measured in a direct line, that is, not following their curve, are $2\frac{3}{4}$ inches in length and slightly deeper measured transversely than they are laterally, and taper to a point.

C. 5. The third pair are $3\frac{1}{4}$ inches long.

C. 6. The fourth pair are $3\frac{3}{4}$ inches long.

It is not necessary to give the lengths of the remainder of the ribs, but it may be remarked that I find in the salmon, that the first two pair of ribs may be termed short, and that from and including the 3rd pair, to and including the 13th pair, they are of much greater transverse than longitudinal diameter, decreasing in the length of the transverse breadth as they succeed each other posteriorly—7 to 12 are the longest and broadest ribs. The remaining ribs are widest at their attachment and gradually decrease in size towards their points.

C. 27. At the 25th pair of ribs on the 27th centrum are a pair of

very short spinous processes lying in front of their articulation with their centrum.

C. 28. The 26th pair of ribs have spinous processes about $\frac{1}{8}$ of an inch in length, to which they are attached and pass posteriorly to their articulation.

C. 29. The 27th pair are united by cartilage to the end of, and behind spinous processes $\frac{1}{2}$ an inch in length on the 29th centrum, their ends do not reach the centrum but are attached posteriorly to the sp. processes. This pair are not so flat as their preceding ribs.

C. 30. The 28th pair. The spinous processes to which this pair are attached are $\frac{5}{8}$ of an inch in length, and their attachment rather more than a quater of an inch.

C. 31. The 29th pair are attached posteriorly to strong sp. processes $\frac{5}{8}$ of an inch in length, which are united transversely forming the first hæmal arch.

C. 32. The 30th pair. Their spinous processes are also about $\frac{5}{8}$ of an inch in length to which the attachment of the ribs is about $\frac{3}{16}$ of an inch.

C. 33. 31st pair of ribs } have sp. processes $\frac{3}{4}$ and $\frac{15}{16}$ of an inch
C. 34. 32nd do. } in length, and have short attachments to their processes.

C. 35. On this centrum, (the last of the abdominal centra), attached to spinous processes, which are united at their ventral ends, are the 33rd and last pair of ribs. A hasty examination of this specimen might lead one to say that it has only 32 pairs of ribs; but the dorsal ends of the 33rd pair are attached closely together and to the narrow point of their sp. processes, and are anchylosed. The examination of younger fish makes this certain. This pair of united ribs forms the support of the anterior interspinous fin bone of the anal fin, which in this case it overlapped, and was attached on the right hand side about $\frac{3}{8}$ of an inch.*

The ventral ends of the last five or six pairs of ribs gradually approach each other until they touch in the last or 33rd pair,

* The sp. processes of the 29th, to and including the 33rd and last pair of ribs, are transversely united, making five abdominal hæmal arches.

producing the beautiful outline of the posterior part of the salmon.

C. 36. On this centrum, (the first of the caudal centra proper), the spinous processes are $1\frac{1}{8}$ inches in length, and attached posteriorly for $\frac{3}{16}$ of an inch is a bone or bones having an extreme divergence from the normal angle, which might be taken for a pair of ribs. The sp. processes, of which mention has been made, are all of the same character as the dorsal and other spinous rays, that is formed of two bones, one springing from each side of the arch and united more or less strongly, as the age of the fish may be. This bone, or if you choose pair of bones are anchylosed and appear as one, their length from the junction with the sp. processes is $2\frac{3}{16}$ of an inch; in the skeleton before you the separation of their ventral ends is a consequence of their dryness. An examination of younger fish will show you that this bone (or bones) originates in a different way from the ribs; looking at this skeleton of what may be called a mature fish, it appears to be a single bone and to have originated and grown from the end of the spinous process, passing and uniting with its next posterior ventral spinous ray having its ventral end attached to the end of the 3rd interspinous fin bone of the anal fin which it slightly overlaps, say $\frac{1}{4}$ inch on the outer or right hand side. In a young fish you will find the spinous processes, but the long bone is merely a short straight bone lying between the processes on the 36th and 37th centra; in the skeleton of the young fish before you the bone does not touch the posterior edge of the 36th sp. process, but is about $\frac{1}{16}$ of one inch from it and it just touches the anterior edge of the spinous process of the 37th centrum, the end of which it does not reach by nearly half an inch; it is therefore most probable that it grows from a centre each way, that is dorsally and ventrally, but that its growth is most rapid towards its ventral extremity.

C. 37. On this centrum (counting the ribs as sp. processes) the 35th ventral sp. ray is attached, and is the first ventral sp. ray having the usual form; it is $1\frac{1}{4}$ inches in length, its ventral anterior extremity is united by cartilage to the bone just mentioned as springing from the end of the 34th sp. process, the great

divergence of which will be perhaps better understood by mentioning that while it lies at an angle of about 14° with the spinal column, the ventral sp. ray springing from this centrum forms its angle about 65°.

C. 38. The spinous ray No. 36 is about $1\frac{3}{4}$ inches long (being a sudden increase of length) and is free—that is, only attached by tissue to the interspinous fin bones of the anal fin. It and the succeeding four spinous rays have wide ventral ends for similar attachment, and are of about equal length.

C. 39. The end of the 37th sp. ray has opposite its point the 4th intersp. bone of the anal fin.

C. 40. The 38th sp. ray has opposite its anterior edge, the 5th intersp. anal fin bone, and opposite its point, the 6th intersp. fin bone.

C. 41. Slightly in front of the 39th sp. ray is the 7th intersp. fin bone, and the 8th is opposite its point.

C. 42. The 40th sp. ray has opposite its centre, the 9th intersp. fin bone; and the dorsal extremity of the 10th and last intersp.
C. 43 fin bone of the anal lies exactly between this and the 41st sp. ray, which is about the same length as the five preceding rays, but its ventral end is somewhat narrower.

C. 44. The 42 sp. ray.
45. " 43 "
46. " 44 "
47. " 45 "

The ventral extremities of these 4 spinous rays are about the same breadth as the 41st, but the tissue attaching to them, the posterior edge of the 10th intersp. fin bone of the anal, which curves posteriorly, (its ventral end being opposite at right angles to the end of the 44th spinous ray, in order to afford sufficient support), is stronger than that in some other parts of the fish. The total depth of the skeleton at the anterior edge of the anal fin to the edge of the dorsal sp. rays is 5 inches, and at its posterior edge $3\frac{1}{8}$ inches.

C. 48. The 46 sp. ray.
49. " 47 "
50. " 48 "
51. " 49 "
52. " 50 "

These sp. rays are regular in shape, but their ventral ends are not expanded, they show a gradual decrease in length, which begins from the 41st sp. ray, the 50th ray being $1\frac{1}{8}$ inches long.

C. 53 51. This ray is stronger than those immediately pre-

ceding it. Its breadth is about equal throughout. It has a somewhat blunt ventral end, and it is $1\frac{1}{4}$ inches long; in the slight hollow between this and the 49th sp. ray, is attached the beginning of the caudal muscle which envelopes the short rays of the caudal fin.

C. 54. Opposite the end of the 52 sp. ray begin the short ventral rays of the caudal fin at right angles to the posterior edge of the 56th centrum. The character of the attachment of the ventral sp. rays appears to change with this centrum, their dorsal ends have spread and are in one sense flattened and seem to have an articulated surface as may be noticed by looking at the 52nd, 53rd, 54th, 55th and 56th ventral sp. rays on this skeleton. The posterior edge of this ray (52) is anchylosed with the anterior edge of 53 for about two-thirds of their length from their dorsal towards their ventral extremities.

C. 55. The 53 sp. ray. } these bones are more or less perfectly
56. " 54 " } anchylosed, their shapes are so irregular
57. " 55 " } that only a drawing (which I regret to say I am unable to make) or reference to the skeleton can give you a clear understanding of them.

58—56th sp. ray. This ray is anchylosed on its anterior edge to the 55th sp. ray for about half its length, say $\frac{5}{8}$ of an inch, and on its posterior edge rather more than half its length, say half an inch from its foramina* towards its ventral extremity, to the lower hypural bone; on its ventral end it is free, say $\frac{7}{16}$ of an inch. In shape this ray differs from all the others, at its dorsal end it is somewhat triangular, having a cup-like projection on each side at its junction with its centrum, and its ventral end is included in a cartilaginous rim which passes round the bones forming the termination of the column. This bone, together with the two saddle bones on the dorsal aspect of the spine, appear to me to be the representatives of the pelvic bones in mammals.

* The foramina in this bone are for the passage of the blood vessels. The superior in this specimen passes to the left, the inferior to the right side, each opening into a sack or sinus having a communicating foramen which lies between the first lower and second lower hypural bones There is also a foramen at the junction of this bone with the anterior edge of the lower hypural in this specimen, of considerable size, in others smaller in proportion.

59–$\frac{1}{H}$. To this vertebral centrum is attached the lower hypural bone, which has a somewhat narrow neck, caused by a foramen on its anterior edge, which passes between it and the ray on the 58th centrum, and a double foramen passing between the posterior edge of this hypural bone and the anterior edge of the second; this double foramen appears to be for the passage of vessels uniting the (pulsating?) sacks. Also attached to this centrum is the second hypural bone; it is notched on its ventral anterior surface by the foramen above mentioned, the division of which is nearly parallel with the centrum; this division is caused by a slight projection in the centre of the foramen on this, as well as on the bone already described. At the posterior extremities the adjacent faces of the above two bones are partially rounded, that is, their adjoining corners are rounded off, and in the hollow thus formed, which is slightly above a line drawn through the centre of the spinal column, is a nervous corpuscle, so shrunken in this skeleton as now to be scarcely observed, but when fresh, it measured three sixteenths of an inch in diameter. This corpuscle projects slightly beyond the edge of the hypural bones. *60.* Attached to the ventral surface of a spongy centrum is the third hypural bone, and to its end, if indeed it does not belong to it, is attached the fourth hypural bone, terminating the sixty centra of the spinal column. We have therefore four hypural bones, which being strongly connected together as well as to the posterior ventral rays, form a broad solid plate for the attachment of the muscles, and the strengthening of the rays of the caudal fin. The bone lying next above this is the larger Y shaped bone, the notochord passes between the forks of this bone as in the smaller bone of similar shape.

Prof. Huxley's drawing, representing the tail of the *Salmo* published in his "Manual of the Anatomy of Vertebrated Animals," page 20, is incorrect if the *Salmo* of England are the same as ours. He makes the vertebral column in this drawing to end in a line common to the anterior vertebræ, and at the end of the last centrum which is drawn of greater diameter than those which precede it, is attached at an angle nearly equal to that formed by the posterior part of the spinal column in the skeleton before you, a terminating bony plate,

and to the ventral edge of this are attached *two* hypural bones. There are also some other bones which do not correspond to some in our *salmo.* On page 131 of the same work he says, "the spinal "column appearing to terminate in the centre of a wedge-shaped "hypural bone, to the free edges of which the caudal fin rays are "attached, so as to form an upper and a lower lobe, which are "equal or sub-equal. This characteristically Teleostean structure "of the tail-fin has been termed homocercal—a name which may "be retained, though it originated in a misconception of the re-"lation of this structure to the heterocercal condition."

The caudal fin-rays in my specimen are not attached to the "free edges of the hypural bones," but their divided ends overlap the hypural bones on each side; on the dorsal part about five-eighths of an inch; a quarter of an inch on the central, and from a quarter to half an inch on the inferior or ventral part. In the drawing referred to one of the fin-rays is inserted in a notch in the posterior edge of the upper hypural bone, nearly in the place where the corpuscle already mentioned should be.

Transverse Processes.

The transverse processes are attached directly to the centra, and begin on the 1st centrum. The first four are nearly at right angles to the column, and project posteriorly into the fleshy tissue, and are say $\overline{\overset{1}{1\frac{1}{4}},\ \overset{2}{1\frac{1}{2}},\ \overset{3}{1},\ \overset{4}{1\frac{1}{8}}}$ inches in length, from 4 to 25, their outer extremities rising gradually towards the dorsal line. They are of variable length, 1 to $1\frac{1}{2}$ inches, not gradually decreasing, but some long, others shorter—including 26 to 32, they rise rapidly towards the dorsal line, so that their dorsal ends are near to the spinous rays; all the transverse processes arise from their centra posterior to their corresponding ray. Besides the transverse processes enumerated, which are bony, there are some that appear to be attached by tissue to their centra, having soft bony extremities: these have their attachment gradually rising on the dorsal spinous rays, but soon they lose their bony texture, and appear only as threads attached to the muscular tissue.

Dorsal Fin.

The dorsal spinous rays make an angle with the spinal column (speaking generally) of from 35 to 42 degrees, and the first interspinous fin-bone of the dorsal fin consists of three bones anchylosed, appearing at the articulation of the dorsal fin ray as one bone expanding into three. The anterior edge of these bones has a somewhat broad face, three-sixteenths of an inch at its widest part, and it is seven-eighths of an inch in length; from the dorsal end of $\frac{1}{14}$ interspinous bone, springs a very strong fibrous attachment, embracing the inserted ends of the triple intersp. fin bone; it then passes downward and is strongly attached to the end of the 4th intersp. fin bone, (counting the short bones above mentioned, as three), which is the first long intersp. fin bone of the dorsal fin. This bone is slightly in front of the 16th spinous ray, which has no extra interspinous bone. The 16th sp. ray is a little less in length than 15, and from it, to and including the 25th ray, a gradual curve is formed by the extremities of the dorsal spinous rays for the insertion of the dorsal fin and its appendages.*

1st intersp.	fin	bone,	$\frac{7}{8}$	in length.		
2	"	"	"	1	"	these 3 bones anchylosed.
3	"	"	"	$1\frac{3}{8}$	"	

4 intersp. fin bones, is $2\frac{11}{16}$ inches in length, and forms an angle of 42 degrees with the vertebral column, while the sp. ray (16) to which it is opposite makes an angle of 35 degrees.

5 intersp. fin bone $2\frac{5}{8}$ inches lies between the points of 16 & 17 sp. rays, angle 40 degrees.

6 intersp.	fin	bone	$2\frac{1}{2}$	between 17 & 18, angle 43 degrees.
7	"	"	$2\frac{1}{8}$	slightly in front of 19, angle 54 degrees.
8	"	"	2	between 19 & 20, angle 55 degrees.
9	"	"	$1\frac{7}{8}$	slightly in advance of 21, angle 55 degrees.
10	"	"	$1\frac{3}{4}$	slightly in front, of 22, angle 55 degrees.
11	"	"	$1\frac{3}{4}$	between 22 & 23, angle 56 degrees.
12	"	"	$1\frac{5}{8}$	slightly in front of 24, angle 55 degrees.
13	"	"	$1\frac{3}{8}$	opposite the point of 24, angle 52 degrees.
14	"	"	$1\frac{5}{8}$	slightly in front of 25, angle 51 degrees.

*This is much more apparent in the skeleton of the young Salmon.

15 and last intersp. fin bone is $1\frac{1}{2}$ inches in length. It has a prolongation posteriorly for the attachment of the last single together with the double fin ray, and also for the strong fibrous attachment which connects it with the dorsal muscle.

The fin-rays of the dorsal fin are in number 15. By some they would be counted as 14, but further on I will give the reason for counting them as 15.

1st Ray. This ray is so small as to be easily overlooked in young specimens. In this one from its root or articulation with its intersp. bone it is five-sixteenths of an inch in length: the point of it reaches only through the skin, but it is a true ray, having its bony regular articulation just above the anterior face of the short one of the triple bone.

2nd ray. The second ray is five-eighths of an inch, and

3rd ray. the third ray is one and three-eighth inches in length, these first three rays are covered or as it were included in the integument as one ray.

4. The fourth, or first ray having its full length, is three and seven-eighth inches from articulation to point; divided at its ventral extremity to form its articulation on each side of the interspinous bone, as are all the fin-rays.

5 to 10. are all of the same type gradually decreasing in length to ten, which measures two and three-eighth inches.

11. The eleventh ray is two and one-eighth inches.

12. The twelfth ray is one and seven-eighth inches.

13. The thirteenth ray is one and five-eighth inches.

14 & 15. Although apparently so closely united, 14 & 15 are separate fin-rays, having each an articulation, that is, the 15th ray is set within the 14th. They are attached as before stated to the posterior extremity of the 15th intersp. fin bone, and if the first three short rays are to be counted, then should these rays be counted as two, for though they are articulated to one base, yet each is a complete ray.

The height of the interspinous bones of the dorsal fin, to the junction of its fin-rays, from the centre of the vertebræ at right angles to the anterior edge of the fin, is three and a half inches; at the posterior edge, three and a quarter inches; length of dorsal

fin from anterior to posterior edge, (rays only) three and three-quarter inches, and including the end of the last interspinous bone four and a quarter inches.

Adipose Fin.

Of the adipose fin there is little to say. Its anterior edge is opposite the posterior edge of the base of the anal fin, it has no attachment through the dorsal muscle to the general muscular tissue. It appears to be an expansion of the integument, and has its base in the cord of the dorsal muscle, which is somewhat thickened and of firmer structure, (more like a cord), where it appears, more so anteriorly than posteriorly. There does not appear to be in it anything which can be called a fin-ray. I have examined a number of *S. salar* as well as S. *canadensis*, with a good glass without discovering any trace of what might be termed a ray, but I cannot say that the microscope would not bring them to view. The only difference observed by me is that while most are smooth and rounded off at the dorsal edge, some present a few of what might be termed raylets, forming a delicate feathered edge.

Caudal Fins.

At the point of the 54th spinous ray begins the upper or dorsal portion of the muscle of the tail rays: this beginning of the caudal fin, which is enveloped by the muscle consists of eleven short rays or spines, filling in and giving to the tail as a whole its line of beauty, strengthened by the anchylosed dorsal sp. rays, and adding to the propelling power of the tail. These short rays are all divided at their anterior ends (or V shaped) united on each side to the general structure, presenting at the dorsal edges the appearance of single rays.

1–4. 1–4 are short and straight.

5–6. 5–6 are somewhat curved, the 6th more pointed at its outer extremity than the 5th.

7. 7 is single at its insertion and divided into two rays at its extremity, and from its division to outer end somewhat curved and pointed.

8 & 9. The 8th & 9th are single at their insertion as well as at their dorsal ends. 9 is one and a half inches long.

10. The 10th short ray is nearly straight. Between ten and eleven, attached to the upper edge of the 11th short fin-ray, at about $1\frac{1}{2}$ inches from its inferior end is an extra bone $\frac{9}{16}$ of an inch in length.

11. This ray is nearly straight, curving at its outer end to follow the shape of the long rays; it has a very thin pointed ventral end; its length is two and a half inches.

The first short fin-ray is about $\frac{5}{16}$ of an inch long.

The eleventh short fin-ray is about two and a half inches long.

The caudal fin has nineteen long or perfect rays, (their insertion in this specimen will average about one inch in length,) which begin to divide or split up into a great number of fin rays, shortly after the exit of the tail from its root or body of the fish. The first and second rays counting from the dorsal region are exactly opposite to the centre of the elevation of the spinal column, so that there are seventeen whole rays beneath it.

1 to 8. The first eight rays are closely united by strong fatty tissue to their emergence from the integument.

8 to 9. Between the inferior ends of eight and nine there is a space of irregular outline filled with fatty tissue which extends some distance between these rays, at its widest part it measures $\frac{3}{16}$ of an inch.

9 & 10. The inferior extremities of these rays meet for $\frac{3}{8}$ of an inch and are then separated for about $\frac{5}{8}$ of an inch.*

10 & 11. Are separated at their emergent ends.

11 & 12. do. do. do.

The 9th, 10th, 11th & 12th rays are broader on their inserted ends by cartilaginous matter, than are the other rays.

12 & 13. The inserted ends of 12 and 13 join for about a quarter of an inch, but are then widely separate, and the ray thirteen is inserted into the root of the tail an eighth of an inch more than twelve.

All the spaces enumerated above, beginning between eight and nine and continuing to that between twelve and thirteen extend into the tail proper as a sort of web by which the tail may be expanded and contracted in its width.

* 10th ray.—A line drawn through the centre of the spinal column touches this ray, the centre ray of the caudal fin.

13 & 14. Are close together to the beginning of the tail proper.
14 & 15. Are close at their inserted ends, slowly separating until divided for the expanse of the tail, when they appear as close together.
15 & 16. Almost unite for one inch, they then appear as slightly separate.
16 & 17. Inserted ends close, then very slight separation.
17 & 18. Same as above.
18 & 19. Close together, nineteen being the ventral ray. The first three outer rays of both aspects of the caudal fin, dorsal and ventral are very strong.

The short rays of the caudal fin on the ventral side beginning at the end of the fifty-fourth spinous ray, are eleven in number

1st. This short ray which is next the nineteenth caudal ray proper, is $2\frac{1}{2}$ inches long.

2nd. The second short ray is 2 inches long.

} these two are nearly straight and pointed at either end.

3rd. The third short ray is $1\frac{3}{4}$ inches long; pointed and slightly curved laterally.

4th. The fourth short ray is $1\frac{1}{16}$ inches long; more curved laterally than the third.

5th. The fifth short ray is 1 inch long; slightly curved.

6th to 11th. These are all curved more or less, and the eleventh is a quarter of an inch long. The points of these short rays are united as the spinous rays, and enveloped as the dorsal short fin-rays by the tail muscle; they have a little more separation than the dorsal short fin-rays, and are deeper than their breadth.

Anal fin.

The anal fin begins, or rather the anterior end of the first intersp. fin bone is attached, as before stated, to the end of the 33rd pair of ribs (on the 35 centrum). This intersp. bone is $2\frac{5}{8}$ inches long, and has upon its ventral anterior surface a heart-shaped shield, half an inch wide at its dorsal edge, and in depth $\frac{3}{8}$ of an inch, which is attached by cartilage to the intersp. fin bone. On the lower face of this shield or plate is a short cartilaginous ray, (half an inch long) having a bony base. It has no articulation

but cartilaginous matter between it and its suspending plate. This soft ray is so closely covered with fatty tissue as scarcely to be noticed unless by dissection.

1st ray. Directly in a line with the first intersp. fin bone is the first short fin-ray, which (as do all the remaining fin-rays) divides at a short distance from its articulation with the intersp. fin bone, one half passing to each side of it, the foot shaped joint pointing posteriorly being comparatively shorter than the others. The length of this ray is $1\frac{1}{8}$ inches, and its anterior face is attached by tough fatty tissue to the rudimentary ray first described.

2nd. The second short fin-ray is directly opposite, and attached to the end of the second intersp. fin bone, shaped like the first. It is $1\frac{3}{4}$ inches long.

3rd. The third or first perfect fin-ray is attached to the anterior edge of the third intersp. fin bone, and this in its turn is attached to the end of the peculiar spine, which springs from the thirty-sixth centrum, and to which as before noticed the end of the thirty-fifth ventral sp. ray is united. And here it would seem that as this is the first perfect or full length fin-ray of the Anal, some provision was required to add to its strength, which is attained by the junction of the thirty-fifth spinous ray with this long slight bone. The thirty-sixth sp. ray being directly between the third and fourth intersp. bones, leaves a space rather more than one-fourth of an inch in width and thereby changes the angle of the remaining intersp. fin bones. Thus the general angle formed by the first intersp, fin bone with the spinal column, which intersp. fin bone is attached to the thirty-third pair of ribs, is thirty degrees, while that formed by the fourth intersp. bone is thirty-seven degrees.

4th. The fourth fin-ray is attached to the centre of the fourth intersp. fin bone.

$$\left.\begin{array}{llll} \textit{5th.} & \text{Same attachment to five.} & & \\ \textit{6th.} & \text{"} \quad \text{"} & \text{"} & \text{six.} \\ \textit{7th.} & \text{"} \quad \text{"} & \text{"} & \text{seven.} \end{array}\right\} \text{intersp. fin bones.}$$

The 3rd, 4th, 5th, 6th and 7th fin-rays are thicker than the others.

8th. The eighth fin-ray is not so strong as its anterior five rays,

and is attached to the eighth intersp. fin bone. As the length of the rays of the anal decrease so does their strength, but much more in proportion in this and the remainder of the rays.

9th. The ninth fin ray is on the 9th intersp. fin bone, which is slighter in proportion than the 8th or 10th intersp. fin bones. The tenth intersp. fin bone, the end of which lies between the 41st and 42nd spinous rays, with its posterior ventral extremity opposite at right angles to the end of the 44 sp. ray, is, as will be noticed by you, differently shaped from all the other intersp. fin bones of this fin, (somewhat resembling the posterior intersp. fin bone of the dorsal fin) having a strong posterior curve at its ventral extremity, and an increase in breadth, presenting a broad face (or end) for the articulation of three fin rays, counting, as on the dorsal fin and for the same reason, the last rays as two. Its extreme posterior edge is furnished with the usual attachment for the muscular tissue which supports the posterior edge of the fin.

10th. The tenth fin-ray is attached to the anterior edge of the tenth intersp. fin bone, which as just noticed has a slight projection for its articulation.

11th & 12th. These two fin-rays lie closely together, but as they have a double articulation, (as the two on the dorsal fin,) they clearly must be called two distinct rays. They are also (as in the dorsal) articulated one within the other, and attached to a slight depression closely in front of the posterior edge of the tenth interspinous fin bone.

Mem.—1 intersp. fin bone $2\frac{5}{8}$ inches long.

2	"	"	"	$2\frac{5}{8}$	"	"
3	"	"	"	$2\frac{1}{2}$	"	"
4	"	"	"	$2\frac{1}{8}$	"	"
5	"	"	"	$2\frac{1}{16}$	"	"
6	"	"	"	2	"	"
7	"	"	"	$1\frac{7}{8}$	"	"
8	"	"	"	$1\frac{3}{4}$	"	"
9	"	"	"	$1\frac{5}{8}$	"	"

10 " " " $1\frac{3}{4}$ inches long to depression for attachment of the eleventh and twelfth fin rays.

1–5. The 1st, 2nd, 3rd, 4th and 5th fin-rays are slightly separated from each other.

5 & 6. Between 5 and 6 there is nearly $\frac{1}{8}$ inch of space.

6 & 7. Between 6 and 7 a little more, say $\frac{1}{8}$ inch of space.

7 & 8. Between 7 and 8 a little more than $\frac{1}{8}$ inch of space.

8 & 9. Between 8 and 9 a full $\frac{1}{4}$ of an inch of space, just below their articulation.

9 & 10. Between 9 and 10 not quite $\frac{1}{4}$ of an inch of space.

10 & 11. Between 10 and 11 just perceptibly more than between nine and ten.

11 & 12. touch but are not united, and are therefore separate rays.

Ventral Fins.

These fins are attached to two bones which are imbedded in the strong fatty muscular tissue in the belly of the fish. They appear on its surface opposite at right angles to the 12th dorsal ray, and are attached to the two bones already referred to, commonly called the pelvic bones, which in this specimen are $3\frac{1}{4}$ inches in length, measured from the centre of the left bone to its point or termination of its junction with the bone of the right side to which it is united* by cartilage, forming a somewhat rounded termination. For convenience I will take one, the left of these bones. You will notice at once its peculiar shape, its posterior end has a stout transverse ridge; extending and springing from this laterally on its outer edge is a ridge increasing a little in size until it is about $\frac{1}{8}$ of an inch in thickness, rounded on its dorsal aspect and projecting rather more than $\frac{1}{16}$ of an inch above a thin bony plate $\frac{5}{8}$ of an inch in breadth at its posterior extremity; decreasing anteriorly to a point which is united to the transverse ridge as far as its inner end, and extending along the lateral ridge two inches, this lateral ridge being prolonged anteriorly $\frac{3}{4}$ of an inch beyond the thin plate or blade. On the ventral aspect the plate or blade rises, following the curve of the lateral ridge which in consequence does not show any abrupt projection. The posterior end of the bone or transverse ridge is, in this specimen, one inch in breadth, and to it the

*In young specimens they can scarcely be said to be united.

fin-rays are attached. The outer head of the transverse ridge projects a little beyond the lateral ridge, the space so formed being filled with cartilaginous matter from which springs ligamentous attachment running some distance along and tying this bone with the muscles of the belly. On the inner edge of the bony blade and attached to the cartilage on its anterior edge, strong fibrous tissue passes enveloping the blade as well as the anterior ends of the lateral ridge, from thence passing to the general muscular tissue. A similar attachment passes posteriorly from the cartilage between the pelvic bones, having attachment to the inner ends of their transverse ridges, with divergent connections to the integument covering the rays immediately under the point where the inner fin-rays appear upon the surface of the fish, from thence continuing some distance as a strong band down the centre of the belly. The pelvic bones are not always parallel with a line drawn through the centre of the belly, but are occasionally somewhat distorted, that is each forming a different angle with such central line.

The ribs from and including No. 15 & 22 are shorter in proportion than the others; this is in order to allow for the insertion of the pelvic bones, thus preserving the line of beauty. The space so afforded by the shortening of these ribs is 4 inches in length; (that is from the end of 14 to 22,) the length of the pelvic bones being $3\frac{1}{4}$ inches, and from them to the extreme posterior end of the long fin-ray is $3\frac{3}{4}$ inches, making a total length of the fins and their attachments $6\frac{5}{8}$ inches average, allowing for the overlapping of the fin-rays upon the pelvic bones. It must however be borne in mind that the fin-rays owing to their curves, are of eccentric lengths, there being a difference in the measurements as they are taken from the dorsal or ventral aspects; in the lengths above I have taken the dorsal aspect in a straight line (not round the curve of the ray), the measurement of the ventral aspect of the same ray is $3\frac{1}{2}$ inches.

The ventral fins each contain 9 rays and each fin has a ventral appendage, in this case they are $1\frac{1}{2}$ inches in length.

1st. The first or outer ray divides at $1\frac{1}{4}$ inches from its attachment to the pelvic bones (that is visibly); on its ventral aspect it is at-

tached to the pelvic bones by fibrous tissue and has a curved termination: on the dorsal aspect it curves strongly, forming a double heel each $\frac{3}{8}$ of an inch in length. The dorsal aspect is strongly attached by fibrous tissue to the outer head of the pelvic bone; and the inner heel is also embraced in similar attachment, together with the flat bony root of the ventral appendage ("axillary scale" of Dr. Gilpin,) from the outer side of which passes a muscle into the general muscular tissue. From the outer heel a strong muscle is attached passing in the same way. It may here be mentioned that there is a strong band of muscular fibre passing forward from the ventral appendage, which, with its other muscular attachments, causes these appendages, when the ventral fins are in motion, to pass under them so as to protect the hollow which appears at the root of the ventral fin, preventing the lodgment of any floating material, such as sawdust or chips in what must be a sensitive part. As soon as the ventral fins are at rest these appendages withdraw themselves and lie parallel with their outer edge.

Dorsal aspect ventral:

1st.	The	first	ray measured in a straight	line from heel to extremity	is	$3\frac{1}{2}$	inches	in length.
2nd.	"	second	"	"	"	$3\frac{1}{2}$	"	"
3rd.	"	third	"	"	"	$3\frac{1}{4}$	"	"
4th.	"	fourth	"	"	"	3	"	"
5th.	"	fifth	"	"	"	$2\frac{3}{4}$	"	"
6th.	"	sixth	"	"	"	$2\frac{1}{2}$	"	"
7th.	"	seventh	"	"	"	$2\frac{1}{8}$	"	"
crowded.								
8th.	"	eighth	"	"	"	$2\frac{1}{8}$	"	"

The heel of the eighth is not like those of the previously mentioned rays, as its anterior end is very slightly raised towards the dorsal aspect, and slightly curved in opposition to the heels of the other rays; it passes very close to, and almost under the heel of No. 7 and near to the pelvic bone.

9th. The ninth ray has no heel on the dorsal side, but it has a slight upward curve in its line of direction tending towards the other rays, its length is $1\frac{3}{4}$ inches, its anterior extremity passes

also close to the heel of No. 7 giving a crowded appearance to the last three rays, which are attached by strong fibrous tissue to the dorsal side of the inner ventral heel or broad plate of No. 9, which is turned inwards towards the outer side of the fin in opposition to the heels of the other rays, (it being the only ray having this peculiar form); this broad plate is in its turn attached to the stout transverse process of the pelvic bone upon which its ventral surface moves; in addition to this broad plate it has upon the ventral side the usual termination. The rays No. 2, to and including 8 are nearly of the same shape.

Ventral aspect, Ventral fin.

Here the rays, may, at their anterior ends be said all to curve towards the centre of the fish.

1st ray. The curve of the first ray fits upon the ventral aspect of the enlargement or head of the outer edge of the pelvic bone, having very strong ligamentous attachment.

2nd. The second has the same attachment, its curved end terminating on the inner edge of the ventral aspect of the outer head of the pelvic bone.

3–9. The remaining rays have all a similar attachment, their anterior curves becoming less, until No. 9 is almost straight, and the ends of all gradually receding.

The dorsal heel of the 2nd ray is opposite to its ventral extremity, but the other rays gradually recede on the dorsal side until the anterior extremity of the 9th ray ventral aspect is one quarter of an inch in advance of the dorsal side of the same ray.

When the ventral fins are in motion or extended, all the anterior ends of the fin-rays appear closely crowded together, more so on the ventral than upon the dorsal aspect.

You may perhaps remember that in describing to you the dorsal aspect of the spinal column, your attention was drawn to two bones lying above the 57th centrum, covering it together with the 58 and 59th and partially that which may be called the 60th centrum, leaving on the dorsal aspect three centra unprovided with spinous processes; on the ventral aspect your attention was also directed to a conical process different from all the other spinous processes which I said together represent in my view the

pelvic bones. The bony plates to which are attached the ventral fins, together with the fins are usually called the pelvic limbs, but it appears to me there can be little doubt that the so called pelvic bones with the fins are the representatives of the hind legs of mammals, thus:

The saddle bones and the bone with the cup shaped orifices below them, are the pelvic bones.

The centra without spinous processes, the sacral vertebræ.

The large hypural bone, the femur.

The pelvic bones, or the bony plates to which the fins are attached; the tibia and fibula and the ventral fins generally the feet.

The Shoulder girdle and Pectoral fins.

At the junction of the body with the head under the opercular plate, appears on each side of the fish a series of bones forming the fore frame and support of its body, and from which spring at about two-thirds of their total length the pectoral fins. In the specimen of the salmon before you on their outer sides each set appears primarily to be formed of three bones. Reversing these bones and looking at their inner surfaces there appears to be on each division (right and left side) another bone now anchylosed with the posterior edges of each middle bone or inter-clavicle, and throwing off from their anterior edges a thin process or plate, which passes partially over the lower edges of the supra-clavicles and united to the anterior edge of each of the inter-clavicles, serving as a base for the supra-clavicles and for the attachment of their tissues.

Taking, as in the ventral fins, the shoulder-girdle, left side—removed from the body of the fish, the upper portion the supra-clavicle viewed from the outside has a two-fold* termination, the posterior fork passes freely, apparently without any ligamentous† attachment, into the fleshy tissue; measured in a direct line from base to point it is $2\frac{1}{4}$ inches in length, and its base is a little less than $\frac{5}{8}$ of an inch in breadth. It overlaps the inter-clavicle; at $\frac{5}{8}$ of an inch from its base, anteriorly, arises

*Three-fold, if looked upon as the same bones in the cod are usually accepted.

†I could not find any in three specimens.

another process having a cartilaginous attachment to it, this process is somewhat irregular in shape and rough upon its edges for the attachment of the tissue which unites it to the bones of the skull. It penetrates beyond the marginal point of the pre-operculum and its tissues are connected with the edge of the supporting bone above the fleshy cheek behind the eye, in shape it is nearly straight, slightly curved laterally; from its junction with the supra-clavicle to its point it is about $1\frac{7}{8}$ inches in length; on the anterior edge of its projection or root this small bone is attached by cartilage to the bone which supports the operculum. To enable you to understand this junction I have cut off a small portion of bone from the skull leaving the cartilage entire. Let us turn this bone over and look at its inner face, at the point of junction of the small bone already noticed as supporting the upper portion of the supra-clavicle and diverging from it dorsally in a line with the centre of the root of the small or supra-clavicular bone is a *short* bone having a very strong ligament connecting it with the skull bone at the base of the brain, (it is this short bone which makes in the Cod fish the forked supra-clavicular bone, but it differs from the salmon inasmuch as it is throughout a bone and is not a representative of the process in the salmon which springs from the supra-clavicle,) a pin in the skull of the large skeleton marks the point of connection.

Of the middle piece or inter-clavicle there need not much be said, it is as the supra-clavicle thin and flat and its upper end is inserted under the edge of the supra-clavicle, on its anterior face for nearly $\frac{5}{8}$ of an inch, posteriorly it has a thickened striated edge; its lower extremity which is flat, thin and oval shaped overlaps and is attached to the clavicle, presenting the appearance of nearly concentric plates, the growth of which has taken place apparently from the inner side. In specimens freshly taken this bone has considerable freedom of motion upon the clavicle.

The Clavicle, Coracoid, Scapula, &c.

It is almost impossible for me to describe the shape of the clavicle and the bones connected with it, but I will make the attempt.

The clavicle from its inferior edge to the extremity of its anterior horn is in this specimen:—$2\frac{3}{4}$ inches in height; $3\frac{3}{4}$ inches in length, from posterior to anterior end, and measured on a line through its centre; the inter-clavicle is attached to it for about $1\frac{1}{4}$ inches, measured from the top of its anterior horn, and the shape of its superior extremity nearly corresponds to that of the inferior extremity of the inter-clavicle; on its inner side, near its posterior edge, there is slightly projecting from it a thin bony plate, terminating at the lower edge of the clavicle to which it is anchylosed, it has a narrow rounded end, this unites with the posterior edge of the accessary bone—its lower rounded end is close to it. The accessary bone arises about midway on the posterior edge of the clavicle, at the junction of the division of its thin posterior plates, and is anchylosed with it; it becomes gradually thicker for nearly one-third of its length and then decreases to its inferior end where it has the usual enlargement for its attachment to the strong muscular tissue in this part of the fish, its interior edge projects $1\frac{1}{8}$ inches below the clavicle, and its posterior edge $\frac{7}{8}$ of an inch. This accessary bone passes inside of the pectoral fin, and gives support to it; it is entirely different from that of the cod-fish in shape as well as attachment. In the cod, as you will see by the specimen (pectoral fin, clavicle, etc., shown), it is a free bone, lying loosely upon the upper posterior edge of the clavicle.

The scapula joins at its superior extremity the upper edge of the clavicle, and its inferior extremity the upper posterior division of the coracoid bone; its posterior inferior extremity is also attached by cartilage to the posterior edge of the bones, which represent the radius and ulna.

The coracoid at its posterior extremity is divided. Its upper edge is united with the scapula, as already mentioned; its lower limb, which is the longest, has its point attached to the inner central ridge of the clavicle, and it is pierced by two foramina, each of considerable size, one on either edge, outer and inner, the latter being the largest and oval in shape; the posterior edge of this lower limb is united by a band of very thin bone, which follows on the one side its shape, and on the other the outline of

the two nearly circular bones which represent the radius and ulna. The anterior extremity of the coracoid is somewhat twisted, that is, its inner and superior edge rises for its union by cartilage with the clavicle, which sends out from its central ridge a flat process for this purpose.

The Humerus.

If you will look at the under side of the coracoid bone, which on this aspect appears to be nearly flat and somewhat curved, from its posterior extremity to its junction with the clavicle; between the foramina already noticed you will perceive a central ridge, which expands towards its posterior extremity; about midway of its length there appears to be a transverse joining, or symphysis, and following this ridge posteriorly you will see that one edge of it forms the outer side of the inner foramen, and that there is a line or indentation which passes by the edge of the outer foramen to the transverse division from whence we started, this appears to me to be, without doubt, the humerus, but to be positive on this point requires the examination of very young specimens of the salmon, which I regret to say my sight will not permit me to undertake.

Carpal Bones and Pectoral Fin.

The pectoral fin is attached to four ossicles, or carpal bones, with the exception of the upper or long ray, which is directly articulated with the radius—the upper one of these ossicles and the shortest is attached to the ulna; the three lower to the posterior extremity of the coracoid, at the lower part of the bone which I regard as the humerus—all cartilaginously. The lower ossicle is $\frac{3}{4}$, the upper about $\frac{5}{13}$ of an inch in length.

The rays of the pectoral fin are fourteen in number. The first or upper ray is in length, from attachment to posterior extremity or point, $4\frac{3}{8}$ inches, the others gradually decreasing in length until the lowest and shortest is $1\frac{3}{8}$ inches. Looking at the fin on either side the rays are crowded, and set one within the other after the manner of a venetian blind when turned to keep out the rays of the sun, the inner inferior margin being the lowest. The upper or long ray, at its attached extremity is very much stronger than the others, and at this point it

has a wide articulating surface on its inner side or heel for its union with the radius upon which it moves, this surface is furnished with the usual lining and ligaments of such joints; from its inner to outer heel transversely it is in breadth $\frac{5}{8}$ of an inch.

Outer side of the pectoral fin.—The heel of the first or upper ray is $\frac{3}{8}$ of an inch in length, and nearly at right angles to its shaft, the heel inclining away from its supporting bone, and at the same time turned towards the ventral aspect of the fish. The heels of the remaining rays gradually increase their angles or have less abrupt curves until the last two or three rays, when their curves again become sharper, the lengths of all decreasing, but the outer heel of the lowest or short ray preserves nearly the normal shape, and projects an $\frac{1}{8}$ of an inch below the supporting ossicle. On its inner side the heel of the long ray is very stout, and its edge inclining downwards gives it a broad termination for the accommodation of the articular joint. The heels of the next six rays gradually decrease in their length and curves until the 8th ray is nearly straight; the 9th, 10th, 11th, 12th and 13th rays are also nearly straight, but closely crowded together, and the inner heel of the 14th is curved upward and almost overlaps the end of No. 13; the outer heel of 14 is, from outside to outside, $\frac{1}{4}$ of an inch below the inner extremity. All the rays are on each side attached to the base of the fin, by strong cartilage, which fills the division of or the space between the rays, so much so that without destroying the fin, which at present cannot be spared, it is impossible for me to give a more particular description of it.

At the junction of the clavicles, which are connected by cartilage and closely attached to their united ends by strong fatty tissue, is the urohyal bone, in this specimen it is $1\frac{3}{4}$ inches in length, and $\frac{3}{4}$ of an inch in height at its posterior extremity; at this point begins its ventral transverse plate, for half an inch of its length it is very narrow, but it rapidly widens until it attains $\frac{3}{8}$ of an inch, taking a lanciolate form. This bone is perpendicular to the body of the fish, and by its anterior end it is attached to the hyoid bones.

This brings us now to the head of the fish on the ventral

aspect, and my present task is done. I have endeavored to describe to you the bones of the salmon (*Salmo-Salar*) as they appear to me to be. I have no theory to advance or support, and it is too much to expect that in what I have read to you there is no error, but it may serve to help some enquirer on his way, and if such be the result my time will not have been spent in vain.

(*For Figures see Appendix.*)

ART. VIII.—NOVA SCOTIAN FUNGI. BY J. SOMMERS, M. D.

(Read Jan. 26, '80.)

THE present paper affords a very short list of some of the more common species of our mycological flora, the result of a three months' study of a local botanical region.

During the time very many specimens have passed through our hands. Difficulties in diagnosis, want of sufficient time, and the evanescent characters of many of them, have been important factors in determining the length of our list, but we have observed enough to convince us that the fungi are capable of affording a field for study which will take many years of patient and laborious investigation to render complete.

Viewed either from scientific or economic point, the fungi furnish us with interesting matter for study and comparison. Their organization, growth and reproduction afford matter for originality in their treatment by scientists. Their medical and nutritive properties—their parasitical and destructive tendencies supply matter for reflection on the part of the economist.

To the student of nature they are of interest, as situate on the border line between the dead and living things of earth—maintaining the balance of power, devourers of dead organic matter, destroyers of decaying organisms; they supply, also, a bountiful store for hosts of highly vitalized, organized beings, and are not even disdained by man himself.

The local peculiarities of our Province now existing, viz., its dense woods and extensive swampy barrens, furnish favorable conditions for the development of this class of vegetables, which our dry atmosphere would, under other conditions, seriously interfere

with. The progress of arts and agriculture in the future, will with them, as in the case of our higher indigenous plants, cause their disappearance, the present is therefore the time to classify them and record their existence.

ORD. I.—AGARACINI.

SERIES—Leucospori.

SUB. GEN.—Amanita.

1. Agaricus (Amanita) vaginatus, *Bull.* Under hemlock and pine, N. W. A., Hx. Sept.

2. Agaricus (Amanita) adnatus, *Smith.* Under spruce; Point Pleasant, Hx. Sept.

3. Agaricus (Amanita) muscarius L. Not uncommon in same situation as above. September and October. Poisonous.

SUB. GEN.—Tricholoma, Fr.

4. Agaricus (Tricholoma) columbetta, *Fr.* Park woods; under spruce. Oct.

5. Agaricus (Tricholoma) crassifolius, *Berk.* Under spruce; Park woods. Oct.

SUB. GEN.—Clitocybe, *Fr.*

6. Agaricus (Clytocybe) laccatus, *Scop.* Common in most situations. Aug. to Oct.

SUB. GEN.—Colybia, *Fries.*

7. Agaricus (Collybia) dryophilus, *Bull.* Point Pl. Park, Hx. Oct.; on decaying leaves, etc.

SERIES—Dermini, *Fr.*

SUB. GEN.—Naucoria, *Fr.*

8. Agaricus (Naucoria) nuceus, *Bolt.* In the Park woods; under spruce fir. Oct.

9. Agaricus (Naucoria) pediades, *Fr.* In open spaces. Oct.

SUB. GEN.—Galera, *Fr.*

9. Agaricus (Galera) ovalis, *Fr.* On cattle droppings in woods. Nov.

SERIES—Pratellæ, *Fr.*

SPORES—Purple or intense Brown.

SUB. GEN.—Psalliota, *Fr.*

10. Agaricus (Psalliota) campestris, *L.* Everywhere in cultivated land, and pastures. Common mushroom.

SUB. GEN.—Pilosace, *Fries.*

11. Agaricus (Pilosace) eximius? *Peck.* On a decaying log; the Dingle, N. W. A., Hx. Sept.

SERIES—Coprinarii, *Fr.;* Spores Black.

SUB. GEN.—Psathyrella, *Fr.*

12. Agaricus (Psathyrella) gracilis, *Fr.* On cow droppings. Sept. In pasture; Dutch Village.

GENUS—Coprinus, *Fries.*

13. Coprinus micaceous, *Fr.* Common on dung and compost Aug., Nov.

GENUS—Cortinarious, *Fr.*

SUB. GEN.—Dermocybe, *Fr.*

14. Cortinarious (Dermocybe) cinnamomeus, *Fr.* In grassy spaces in the Park, Hx. Sept.

GENUS—Lepista, *Smith.*

15. Lepista personata, *Fr.* Park woods, Hx. Sept.

16. Lepista cinerascens, *Bull.* Under spruce and pine; Park. Oct.

GEN.—Hygrophorus, *Fr.*

17. Hygrophorus eburenus, *Fr.* Stem swollen; volva persisting; pileus 4½ inch. Under pines in the Park, Hx. Oct.

GENUS—Gomphidius, *Fr.*

18. Gomphidious glutinosus, *Fr.* Common about Hx. Sept. and Oct. Growing on the soil.

GENUS—Russula, *Fr.*

19. Russula vaternosa, *Fr.* Pine grove; Pt. Pleasant. Sept.

20. Russula alutacea, *Fr.* Under pines; Point Pleasant, Hx. Nov.

GENUS—Marasmius, *Fr.*

21. Marasmius oreades, *Fr.* "Fairy-ring champignon." Borders of woods and roadsides. Oct.

GENUS.—Schizophyllum, *Fr.*

22. Schizophyllum commune, *Fr.* On dead wood; common. Aug.

GENUS—Lenzites, *Fr.*

23. Lenzites betulina, *Fr.* Common on birch and stumps; perennial.

ORDER—Polyporei.

GENUS—Boletus, *Fr.*

24. Boletus lividus, *Fr.* Common. Poisonous. Aug. to Oct.

25. Boletus pachypus, *Fr.* In woods; common. Aug.

GENUS—Polyporus, *Fr.*

26. Polyporus fomentarus, *Fr.* On birch; near Truro, N. S. July.

27. Polyporus annosus? *Fr.* On fallen hemlock trunk; near Truro, N. S. July. Persistent, pores? rich umber brown; margins velvety, of a deeper shade; cuticle dense, sooty, spotted or indefinitely marked; slate colored; consists of two masses, both provided with pores, etc., one resting above the other, but forming one substance, attached? its whole length at one side; body of upper mass extends one inch beyond the lower, the free under surface of this mass provided with pores like the lower one; Margins sinuous; pileus about five inches in width, by three inches in thickness; length, about four inches; very solid; woody; the two masses, viewed as a whole, resemble an agaricus with a very thick stipe; width of lower portion, three inches; thickness, three inches; length, about one and one-half inches. I give its characters in detail, because my diagnosis is a doubtful one.

28. Poloporus versicolor, *Fr.* Resupinate; persistent; common. On larch, hemlock, birch, etc.

ORDER—Hydnei.

GENUS—Hydnum, *Linn.*

SECT.—Mesopus.

29. Hydnum repandum, *L.* Near the roots of pines. Point Pleasant Park, Hx. September.

GENUS.—Sistotrema, *Fr.*

30. Sistotrema confluens, *Pers.* In the Park. Oc.

ORDER—Phalloidei.

GENUS—Cynophallus, *Fr.*

31. Cynophallus caninus, *Fr.* Found by Mr. R. Morrow in a drain on his property.

ORDER—Trichogastres.

GENUS—Lycoperdon, *Tourn.*

32. Lycoperdon cœlatum, *Fr.* Common in pastures. Aug., Sept.

33. Lycoperdon gemmatum, *Fr.* In fields and pastures, Common. Aug., Sept.

ART. IX.—NOVA SCOTIAN GEOLOGY.—NOTES ON A NEW GEOLOGICAL PROGRESS MAP OF PICTOU COUNTY. BY THE REV. D. HONEYMAN, D. C. L., F. S. A., *Hon. Member of the Geol. Assoc., London, &c.; Curator of the Provincial Museum, and Professor of Geology in Dalhousie College and University.*

(*Read May* 10, 1880.)

INTRODUCTION.

THE map exhibited is the first of a series which I have been engaged for some time constructing.

They are all on a scale one inch to the mile. Church's county maps are generally used for topography. Occasionally the Admiralty charts are used in the delineation of harbours and portions of coasts of geological importance. From these and railway section books elevation measurements are largely obtained.

The various papers that I have submitted to the Institute and these maps may be regarded as mutually illustrative.

Additional notes, however, seem to be required, in the case of some maps, for the following among other reasons:

1st. Railways have been, or are being, constructed which are of more or less geological importance. These, in their nature, could not be referred to in papers already communicated.

2nd. New facts may have come to light.

3rd. Certain old facts may have to be brought into connection with these new facts for specific purposes.

The following notes on the progress map of Pictou county seem to be required on considerations as above.

GREAT COAL FIELD.

A prominent feature of our map is an irregular polygon colored black. This is the Pictou coal field as defined by Sir W. E. Logan and E. Hartley. I have simply transferred it from the map

accompanying the Report of Progress of the Geological Survey of Canada, 1868-9.

EASTERN EXTENSION RAILWAY.

I am indebted to M. Murphy, C. E., Government engineer, for the correct delineation of this line of railway on my map. Passengers cannot fail in observing the great scarcity of rock cuttings along the line from New Glasgow to the eastern boundary of the county. Still it has been the means of reaching many points of interest to the geologist, and it has rendered of easy access a district of great interest, whose geology has been imperfectly comprehended and partly misunderstood.

Leaving the New Glasgow station, we start from the northern side of Sir W. Logan's coal area, traverse the lower carboniferous conglomerate of New Glasgow and succeeding grits. Turning eastward we proceed through drift cuttings and occasional sandstones while crossing Sutherland's River and French River. We continue to traverse the Lower Carboniferous through Piedmont Valley. Entering the basin of Barney's River the geology begins to be somewhat obscure. In fact, we are taking a great geological leap. When we pass from the Barney's River strata to the siding at Dewar's furniture factory, we find that we have descended from the Lower Carboniferous to the Middle Silurian period. The geological gap between represents Devonian and Upper Silurian time. We have just crossed the Western branch of Barney's River. Proceeding a short distance we cross a bridge over the middle branch, descending lower in Middle Silurian time. Still farther on we cross the eastern branch of Barney's River. Here strata are seen partly covered by a *dump*. These are the bottom strata of this Middle Silurian series of the several branches of Barney's River. The Middle Silurian series here, as elsewhere, includes A, B and B' of the "Upper Arisaig series." A is equivalent to the "Mayhill Sandstones" of Wales, according to Salter. B′ is of Clinton age, U. S., according to Hall, and B intermediate, according to my own determination, of the typical series in Arisaig Township of Antigonish County. I may state that B' is the "Lower Arisaig series" of "Acadian Geology." Still proceeding on the line of railway, we pass from the base of

the Middle Silurian to a base of strata of Lower Carboniferous age. We thus take a greater leap upwards than was done downwards on our entering upon the Barney's River Basin. The difference is measured by our descent geologically in passing through the Middle Silurian series. Proceeding onward we pass from the Lower Carboniferous into a great Metamorphic series, which enters largely into the constitution of the mountains through which passes the remarkably picturesque "Marshy Hope."

Through this pass flows the eastern branch of Barney's River, and proceeds the line of Railway, in two sub-parallel lines.

A beautiful section of a part of the metamorphic strata is seen on the side of the railway. The latter proceeds onwards through the Valley without any other rock exposures being apparent. About a mile from the County line, strata A. (Middle Silurian) are observed on the side of Barney's River. These extend onward into the County of Antigonish, and are cut by the railway before it reaches the county line. We discontinue our journey until I read notes on the map of Antigonish County.

General Sections.

On the map.

Section line, No. 1.—This section commences on the Pictou and Antigonish Co. line, 2 miles from Northumberland Strait and the same distance from the N. west corner Arisaig Township, the county line being the western boundary of the township. The portion indicated is 3 miles distant from the top of the uppermost member (D) of the typical "Upper Arisaig Series," situate near the mouth of McAra's Brook in the county of Antigonish, and on the Northumberland Strait. This line is *zigzag*, consisting of three straight lines, which I shall designate respectively 1, 2, 3.

Line 1.—Beginning at the starting point proceeds in a direction S. 25 W. to Sutherland's Mountain, *Kenzieville*, a distance of 9 miles. In its course it traverses, 1st. The metamorphic rocks of the Antigonish, and Pictou Mountains. 2d. A carboniferous band of rocks of the same mountains. 3d. A. B. & B. of eastern and middle branches of Barney's mountains, and ends at strata with Diorite, of Sutherland's mountain at the west branch of

Barney's River. I have already incidentally referred to some of the rocks of this section. Having recently made a thorough examination of the Basin of Barney's River, I shall give the results.

Traversing the line of railway, I was led to make Dewar's Furniture Factory siding my halting place. Here I was kindly welcomed and hospitably entertained by the proprietor of the Factory. Examining the dam and race which are situate on the west branch of Barney's River, I was interested to find *silurian strata* where I had expected to find Carboniferous rocks. From cursory observations I had been led to infer that this was a Carboniferous area, and that the Silurian of the east was bounded by the eastern branch of the River. I had supposed Cameron's mountain which was on the right of the road entering the Marshy Hope, which is formed of lower carboniferous conglomerate, to be a continuation of the carboniferous mountains which run on the south of Piedmont Valley. I had also supposed that the Middle Silurian strata (A) which occur on the left side of the same road was a continuation of other strata, occurring in the Marshy Hope at the county line. *See the railway traverse* proceeding.

Accompanied by A. Dewar, I examined the fields to the south of the factory onward to the New Glasgow and Antigonish road in search of the supposed connection of the Carboniferous Mountains without success. We then observed Silurian strata in the middle branch, which led us to follow its course northward to the railway bridge. We found Middle Silurian strata (B) all the way, and, therefore, *no connection* between the Marshy Hope Carboniferous Mountain and the Mountains of the west. We then ascended McPhee's Mountain on the north side of the entrance of the Marshy Hope and found that it also was formed of Lower Carboniferous Conglomerate, like Cameron's, on the south. We afterward examined rocks in the east branch of Barney's River and found that they were the connection between the two mountains, being also conglomerates with the addition of *igneous* rocks. The latter were found to occupy a *central* position, by comparison with the other passage conglomerate outcroppings on the road. The continuation of these mountains on the north was also found to be of Lower Carboniferous age, Cameron's moun-

tain is there connected with the Carboniferous of Merigomish, on the north rather than on the west. It then appears that the metamorphic rocks of the Antigonish and Pictou mountains are *altogether* bounded on the west by Carboniferous rocks of mountains. It at the same time appears that the Middle Silurian (A) strata, on the left side of the road, are completely disconnected with the similar strata (A) toward the county line. These are two note-worthy considerations.

I shall now direct attention to the disconnected Silurian strata. They are brownish quartzose slates, much metamorphosed. They are fossiliferous. The fossils are the usual ones of A of the "Upper Arisaig series." *Petraia, Athyris, Cyclonema.* They are all casts—external and internal. On the east branch of Barney's River, where the railway enters the Marshy Hope, I have refered to similar strata partly covered by a *dump.* These lie to the north of the preceding, and are also cut off from any connection with Eastern Silurian strata by the carboniferous conglomerates and igneous rocks of the same branch of Barney's River. We are thus led to follow a northern course, i. e., down the river. We find them proceeding in this direction, crossing the river at McPhee's, and apparently terminating 3¼ miles from the entrance to the Marshy Hope. I collected fossils in part of these at the road before reaching McPhee's. Two of the specimens lie before me. I shall describe them. The one is a quartzose rock, coloured brown with iron oxide. It has a sharp cast of the exterior of a good sized *Cyclonema.* One side of the specimen has crystals of quartz. The second specimen is of the same character, being from the same mass of rock. It is larger, having a vein of quartz with beautiful quartz crystals. On a corner is exposed a large *Cyclonema,* showing the internal cast entire, also a considerable part of the surrounding external cast. The shell space is entirely vacant. The last specimen is a beautiful and convincing illustration of *rock formation.*

Examining the high ground south of the Marshy hope road, and west of Cameron's mountain of lower carboniferous age, referred to above, we found the southern continuation of our Silurian (A) strata outcropping extensively; after a time it ceases to appear.

We proceeded onward to Mr. McIver's at the back of Cameron's mountain, no outcrops appeared. We then descended McIver's Brook proceeding northward, no strata were seen for a considerable distance, at length strata appeared in great mass, which were found to be our Silurian (A) strata succeeded by B, crossing the brook to proceed westward as mountain strata, including Sutherland's mountain of our section. Their boldness, and hardness of A, have constituted them mountain rocks. Sutherland's mountain strata are tilted ; fossils abound in them, such as Arisaig, and quartz veins are also abundant.

A great proportion of the mountain consists of Diorite. It is well exposed on the back of the mountain reaching nearly to its summit. This is the usual association in Nova Scotia, east and west. In Antigonish, Pictou, Annapolis and Digby counties, strata A of the upper Arisaig series are invariably associated with intrusive Diorite. Succeeding this band are B. & B'. strata, these contrast strikingly with the preceding. They are generally very soft furnishing the *pencil stone* of *How's Mineralogy of Nova Scotia*, when exposed they become clay. The lower strata contains my "Lingula nodule bed." As usual at my last visit I extricated a great number of nodules from its two exposures These contain beautiful *lingulæ* of several species. B strata as usual furnish a great variety of genera and species peculiar to our Clinton period. They will be found included in our *lists of fossils* in the sequel. The west branch of Barney's River is the approximate boundary of this Middle Silurian area. The Carboniferous begins in the river at the mill north of McPhee's Silurian (A) strata. At Dewar's Furniture Factory strata B extended beyond the river. Between Robertson's and the Rev. Mr. McKeehan's, the carboniferous mountains south of Piedmont Valley, have their extremity on the east. This apparent intrusion into the Middle Silurian originally led me to infer a connection with Cameron's mountain already referred to.

Antigonish and Pictou Mountains.

From McPhee's extremity of A (Middle Silurian strata) I crossed the Middle Silurian and then the Carboniferous, and reached the old mountain road at Bailey's Brook. At the bridge and

fulling mill ruins, Igneous rocks were observed, of lower carboniferous age.

A short distance above the bridge I examined a mass of limestone of lower carboniferous aspect. J. McLellan who pointed it out to me, assured me that similar limestone had been quarried in the high ground to the east of the mountain road and used for building purposes. Farther on the road side and mountain sides and summit, outcrops of metamorphic rocks appear, they are quartzites and argillites. No member of the Upper Arisaig series has thus far been seen on the side of this metamorphic series. The carboniferous bands along it from the Antigonish county line to the Marshy Hope road. We shall now examine the south on Marshy Hope side. On the road below W. Robertson's and at the watering place for horses, the felsites of the mountains appear after the carboniferous outcrops, on the left side of the line of railway opposite. At Pushie's is an interesting section of a steep side of the mountain, the rocks of this section are felsites and argillite, the felsites containing *micaceous hematite with pyrite.* Beyond this there do not appear any rock exposures until we come opposite the Marshy Hope station. Here at a bridge over Barney's River, of the road entering the Sutherland settlement, Middle Silurian strata (A) outcrop. Entering the settlement we find argillites with quartzites on the side of a tributary of Barney's River. On the summit of the mountain at Sutherland's Argillite outcrops. These resemble the James River Fall rocks. The latter are in Antigonish county—9 miles east, from the Sutherland mountain outcrop. The Middle Silurian (A) strata of the bridge extend into Antigonish county as far as Lindsay's stables. At McLean's they are cut by the line of railway, after this the railway passes them on the south. I discovered these many years ago with them. *Lingulæ, Petraia and Cornulites* were also found in them from time to time. I was accompanied by the Rev. Mr. Goodfellow and son, when I made my recent examination. We found *Petraia forresteri* (Salter) in the *strata* at Lindsay's stables. At McLean's we found abundance of *Cyclonema, Orthis and Lingula* associated with the characteristic *Athyris* (casts) and *Crinoidea.* From the moun-

tain side above, Mr. Goodfellow brought a piece of rock which was found to be a conglomerate of peculiar character. It is almost identical with the dioritic conglomerate which I found at Wentworth, I. C. R., with other conglomerates and rocks, which led me to proper views of the age of rocks of the Arisaig mountains, and to distinguish them from the "Lower Arisaig series," (Archæan Dana) and "Upper Arisaig series," (Middle and Upper Silurian,) by making a "Middle Arisaig series" and correlating it with Professor Ramsay's "Cader Idris" (Lower Silurian). The distance from the north side of Bayley's Brook to the south side McLean's is 5 miles.

Other Mountains.

My attention was also directed to the mountains on the south side of the Marshy Hope railway. Opposite the Middle Silurian (A) strata last examined, is a Brook (Bryan Daley's) which penetrates these mountains. Ascending this brook the first rocks that I met with were apparently carboniferous strata consisting of clayey shales and conglomerates. Succeeding these are exposures of metamorphic slates — argillites. I shall have to investigate these before I can arrive at any satisfactory conclusion regarding their age. In the meantime I regard them as a continuation of whatever rocks may form the mountains at McIver's, and, therefore, as underlying the strata A, B of the Barney's River Middle Silurian area. The same doubtless extend farther west behind Sutherland's Middle Silurian Mountain of our section, so that they may be regarded as *Pre-Middle Silurian* and, therefore, *Lower Silurian.*

Section line 1, division 2 extends from Sutherland's Mountain to French River—a distance of 6 miles. Its course is N. 80 W. It begins in the diorite of Sutherland's mountain, crosses A strata of the mountains, passes through B strata with its *Lingula nodule bed,* traverses B' south of Cooper's and at Turner's with its Graptolithus clintonensis (priodon), Dalmanites, Leptocœlia, Strophomena, etc., and ends at an igneous rock in French River (a Lower Carboniferous rock).

This Middle Silurian area is intersected diagonally by the line of section. It is bounded on the north by the Carboniferous

mountains—these have been already referred to as on the south of Piedmont valley and the line of railway. The mountains on the south are an extension of the strata of Sutherland's mountain. Strata B and B' lie between.

Division 3 extends from French River to the west side of Irish Mountain, a distance of twenty-seven and a half miles. Its course is S. 55 W. It traverses first an area of Lower Carboniferous rocks, then the Middle and Upper Silurian of Sutherland's River, McLellan's Mountain and Brook, and Irish Mountain, terminating in the Lower Carboniferous of East River.

The Silurian formation retreats after it reaches the west branch of French River, and forms the compound curve which connects the Silurian area of the Barney's and French basins with those of East River basin. The connection is very complicated, consisting of Anticlinals, Synclinals and Monoclinals; yet there is no great difficulty experienced in resolving the complications in consequence of the constant recurrence of well known characteristic fossils and obvious structure. Vide Papers in Transactions 1870-1-2.

Section 2nd.

This section begins where the preceding section ends. Division No. 1 proceeds S. 19 E., a distance of 4.3 miles to Fraser's (sadler). Beginning in the Gypsum it passes through the Lower Carboniferous to the Limestone of McLean's Lime Kiln at Springville, a little farther it enters D strata, with abundance of characteristic fossils. At the late Rev. Angus McGillivray's pasture, it enters C strata with fossils characteristic of this horizon. It then passes through an obscure region, in which we may presume that B′ (Middle Silurian) strata are to be found according to the analogy of the preceding section (No. 1). We then come to a hill having fossils, which show that C strata have been left behind. Reaching Fraser's (sadler) we come to the *first discovered outcrop* of the iron ore of this division, or series, which we would, for future reference, name *Iron Ore, No. 1.* Division No. 2 of the section running N. 59 E., 0.6 of a mile, passes through the lowest strata of this series, which we shall, in the meantime, designate A strata. It then traverses a wide dyke of igneous

Diorite. Division No. 3 runs N. 82 E., a distance of 2.2 miles to John McDonald's Hill, Blanchard, passing through Middle Silurian strata A. At McDonald's hill it cuts an intersecting outcrop of D strata (Upper Silurian) with characteristic fossils. Division No. 4 passes N. 59 E., a distance of 0.6 of a mile, at its termination it cuts the Blanchard Iron Ore. This is a bed of fossiliferous red hematite 30 feet thick. The ore and the containing strata have fossils characteristic of A (Middle Silurian). I will call this *Iron Ore. No. 2.* Division No. 5 runs S. 45 E., a distance of 3 miles. The half of this distance, 2.5 miles, it passes through Middle Silurian strata and then it reaches crystalline metamorphic rocks of Archæan age (Lower Arisaig). It traverses these a distance of 2.5 miles to McPhee's, still on the north side of East River division. It continues in the same direction S. 45 E., a distance of 0.6 of a mile, crossing the river and passing into a band of black metamorphic Middle Silurian strata. These have an east and west strike. At a farther distance of 6.8 miles, west, we reach the first outcrop of Iron ore at McDonald's, due south of Blanchard. I shall name this *Iron Ore No. 3.*

Remarks on the Divisions of Section Line No. 2.

Division 1.

The series of Silurian rocks of this division might be regarded as a typical series, if Arisaig did not put in a prior and superior claim. I shall consider the series of Springville in the order of its development. D. strata at McLean's have received the most attention on account of the abundance of fossils. The fossils and their order of occurrence correspond in a striking manner with the typical D at Moydart, Arisaig Township.

The fossils are, with a few exceptions, of the same orders, genera and species; the mode of their occurrence and association remarkably corresponds. A ledge on the height at the back of McLean's and to the north of David's lake, has precisely the same fauna as a corresponding ledge at Moydart. The fauna are *Cornulites flexuosus, Homalonotus dawsoni, Spirifer subsulcatus* and *Avicula honeymani*, associated and in abundance. The only difference is in the degree of metamorphism and in the state of preservation. All the strata of the series of Springville are more highly

metamorphic than in the type, and the fossils, generally, are less perfectly preserved. C strata here correspond and differ in like manner when compared with the typical strata at Knoydart, Arisaig Township. The *Cephalopoda* are as large as in the type. An orthoceras at Springvllle is the largest found in Nova Scotia. Similar species appear in groups, as in the type. They occur in the same relative position. Remarkable forms are also found in the two localities. Here the strata are more highly metamorphic. This action has also affected the state of preservation of the fossils. They are generally casts. Strata D may be regarded as extending from the north end of Irish Mountain to Holmes' Brook. Before reaching McLean's, however, they seem to break and their course to change. At Macintosh's brooklet they make a sort of a water-fall, near their junction with the Carboniferous Sandstones that underlie McLean's Limestone. From this brook to Holmes' brook we have the D strata of division (1). Their width is considerable. Their outcrop, with fossils, was followed to some distance behind David's Lake. At the back of Irish Mountain C strata possibly exist among the strata of the abrupt descent to Cross Brook. They were not detected from want of fossils. At Holmes' brook their upper part becomes distinct in closest contact with Lower Carboniferous Limestone. Their immediate contact forms a breccia. Here the water sinks, leaving the remainder of the brook dry in summer. The water that has disappeared after a subterranean flow, reappears at Holmes' sluice and flows *sub diu* to the river. Limestone and C strata are seen in approximate contact at the opening; in the strata east of the sluice the large orthoceras was found and other characteristic fossils. In an outcrop not far from the road crossing, on the same side of the sluice, other characteristic fossils were found. The *same strata* are found in contact with the limestone on the river side at McPhee's. These strata passing along N. E. on the N. side of the river form mountains of steep ascent and considerable elevation. In some places the strata are bare, especially toward the mountain summit, resembling a house top of *high pitch*. The lower strata of McGillivray's pasture continue their *rampart* course with a depression on the left onwards to the end of the

mountain, having the same characteristic fossils at the end as at the beginning; limestone is seen here in the river as at McPhee's, although not in contact with the strata.

A RED LETTER DAY IN THE HISTORY OF PICTOU AND GEOLOGY OF DIVISION C.

On the top of a hill at the end of the C strata mountains, on the line of the depression of the mountain summit already observed, on the right of the McGillivray strata I found an exposure of strata lithologically distinct from D. & C. These so much resemble the B' strata of Doctor Brook, Arisaig Township, that I was led to search in them for fossils. This happened on a day ever to be remembered in Pictou, when H. R. H. the Prince of Wales was in Pictou *en route* to Prince Edward Island. Few were in the country that day who could find the ways and means of getting to the town, these not being available I continued my search for fossils and found them. I collected 4 specimens belonging to a new species of Homalonotus which is known in my collection as *Homalonotus Siluriae Principis*—Prince of Wales Homalonotus, two large *lingulæ* were discovered, also a *discina* and a form *Incertae sedis.*

DESCRIPTION.

C and D strata as at Arisaig have each their characteristic homalonotus. The number of specimens of a species of homalonotus found in our new strata of the mountain seems to form a characteristic. *Homalonotus dawsoni* is characteristic of D. *Homalonotus salteri, M. S. is characteristic of C.*

This was considered by Salter from the appearance of the pygidium to be Homalonotus *delphinocephalus.* When examined by him the head of the form was unknown. Specimens of the head were afterwards found which showed that it is not *delphinocephalus.* I have regarded it as a *new species* and named it after the late distinguished Palæontologist of H. M. Geological Survey of Great Britain.

The thorax and pygidium are all that is known of the *Homalonotus Siluriae Principis.* The thorax has the character of the genus, being *level backed*; the pygidium is different from that of *Homalonotus salteri* in not having a terminal spine. From

this and *Homalonotus dawsoni* it differs in being distinctly *trilobate*; the others have their furrows deep and continuous from side to side; this has the side *furrows* coming opposite to the *ridges* of the axis. It is much stouter than the others. The specimens are more or less distorted by metamorphism, the containing strata being highly metamorphic.

The first appearance of homalonotus in the typical Arisaig series is in B', where it is associated with casts of *pentamerus oblongus.*

This leads me to refer the strata in question to B'. The association of the large *lingulæ* seems to indicate the same horizon. as they are found in the same position at Arisaig. These are the only lingulæ found as far as I know at East River. Discina is larger than discina of D Springville; it more resembles the discina of B', French River. The form referred to *incertæ sedis* resembles the valves of a *pholas* open. It is finely striated a cross.

These considerations led me to consider the mountain strata as the upper part of B' of the series.

On the McLellan's mountain road, at the back of McGillivray's is a deserted farm, succeeding an obscure forest area. Here I observed strata which resemble fossiliferous A strata highly metamorphic. I did not succeed in finding fossils in them. I found a *petraia forresteri* in the bed of Holmes' Brook which might have come from a part of these strata, as this brook passes not far from the said *old farm.* The strata of this farm extended in the line of strike, cross the section line, near the position of *Iron Ore No. 1.*

This Iron ore is now an old acquaintance. It is 25 years, less six weeks, since I was first introduced to it by the late Rev. A. McGillivray. Then it was scattered all around his mountain farm. Every cairn of stones had its large masses and small pieces of beautifully crystallized brown Hematite. This led Mr. McGillivray naturally enough to suppose that the vein of ore was situate within the bounds of his farm, and that its discovery would add to the value of his property, especially as the General Mining Association was supposed to have no reservation except for *Gold, Silver, and Lapis Laculi.* Every year, about the same

season, we had a search for the hidden treasure. In 1869, after a freshet, I considered that I had found unmistakable evidences of its position, near the upper outcrop of strata C. In apparently the same position, I came upon the trenches of the General Mining Association, at the end of the C. Strata Mountains, with a great accumulation of masses of ore on the sides of the road, near the bridge that crosses East River.

This led to the conclusion that the vein traversed *Aymestry Limestone* strata. In 1864, when making a preliminary Geological survey for the N. S. Government, *vide Blue Book*, Fraser's ore was pointed out to me in a small brook. There was not the least difficulty in recognising this as approximately *in situ*. Mr. E. Hartley, of the Geological Survey of Canada, sank a pit here and found the ore *in situ*. Considering the strata of Fraser's site as Middle Silurian I was only perplexed by the indications, and led to the conclusion that we must wait until the vein was traced from Fraser's onwards.

I am just waiting for an opportunity of examining the course of Mr. Gilpin's excavations, to satisfy myself in reference to the course of the vein, so as to indicate its geological relations on the map.

The carboniferous approaches the river on the south side opposite Fraser's, as is indicated by limestone or gypsum pits. It likely overlaps, or otherwise joins the ferriferous Middle Silurian as it does the C strata farther down the river.

DIVISION (4.)

Iron Ore No. 2.

This ore corresponds very closely in character and age, with the *red ore* of Nictaux, both are fossiliferous and siliceous. In the ore under examination, *Athyris* is found, which is elsewhere only found in A strata. Its geological horizon has therefore been indicated on the map as Middle Silurian. Mr. Gilpin's explorations seem to confirm this view, as he found its extension at Ross'. Its course is therefore approximately in the strata, outcropping in Squire Campbell's marsh, in which I found a pygidium of Dalmanites of B′ Arasaig and other fossils (Crinoidea). The extension of these at Ross's also produced fossils. They were

sent in my collection of fossils to the Museum of the Survey, Canada.

Division (4.)

Archæan.

I found and examined these rocks outcropping in all directions along the road which leads to Blue Mountain. I have examined them to a distance of two miles. These are separated from the river by a band of Middle and Upper Silurian? strata, which borders on the north side of the river, and comes into contact with a considerable bed of Lower Carboniferous Limestone.

The archæan rocks are felsites. In some places they have appearance of copper and micaceous iron ore. An outcrop of these appears at McPhee's giving the series a width of 2.5 miles. This may be the west side of the *archæan* of the Keppoch and Ohio, Antigonish County. I have not had an opportunity of tracing a connection between the two areas of crystalline rocks.

Division 5.

Iron Ore, (No. 3.)

The rocks of this division contain the specular Iron ore at McDonald's on the south side of the river and S. of Blanchard's. This ore *in situ* was first shown to me by Mr. Donald Fraser in 1861, when I collected specimens of the various ores of the district for the London Exhibition of 1862. It seemed to indicate a deposit of economic importance, subsequently in 1869 when I investigated its geology the outcrop was obscured by an enormous pile of stones on its top, and it was with difficulty that I secured a passable specimen of the ore for our Museum collection. I examined the containing strata and found them to be dark coloured metamorphic strata. On emerging from the woods on my return to the river, crystalline rocks were observed in a field on the right. The outcrop of these is of considerable extent. The rocks are igneous and intrusive, like other rocks of the section on the north side of the river. We had thus the *appearance* of a monoclinal, the dip being southerly and the strike east and west. The extreme metamorphism of the rocks and the general aspect gave no encouragement for the search for palæontological evidence of age in the rocks themselves. I therefore searched for other

exposures on the line of strike. I found the rocks exposed in the course of an adjoining brook. I followed these towards Springville until I came to lower carboniferous rocks, which separate the strata under examination from the strata of Iron Ore (No. 1) on the north side of the river. Afterwards I examined the strata of the division 5 of the section which I found in the river without any carboniferous intervention between north and south, and in proximity to McPhee's *archæan outcrops* In this way the areas of pre-carboniferous rocks having Iron ore on the *one* side of the river, were connected directly with the fossiliferous and pre-carboniferous rocks on the south side. This seemed to be one important element in correlation. Proceeding westward, down the river on its south side, I found one brook with a mill-dam; here is another exposure of the strata under examination. Still farther at Pleasant Valley another brook occurs having a mill-dam, and an exposure of the same strata. In addition I observed strata of lighter colour and greater compactness, I readily recognized a lithological feature of frequent occurrence at mill seats on Sutherland's river and its branches, where palæontology is available for the solution of difficulties. There I had to refer the corresponding strata to A and B B', middle silurian. If lithological evidence is worth anything in correlation, it surely is of some weight in the same district even at the distance of 9 or 10 miles.

The next exposure is in the brook east of the *situs* of *Iron ore, (No. 3,)* McDonald's brook. Here we have the best exposure of the strata. Along this brook I examined the strata to a considerable distance southward in search of a continuation of the Iron ore without success. Returning I reached an old mill-dam having strata of the same lithological character as the preceding, indications of A, B and B', middle silurian. Proceeding still along the bed of the brook, I found, after a considerable interval of obscurity, compact strata, having a southerly dip. These strata are hard and jointed *with films of micaceous oxide of iron in the joints.* Succeeding these at the bridge which crosses the road running up the south side of the river, I found black slates having obscure fossils, but which I have little doubt are of

Clinton age, farther on where the brook enters the river is a green marble of lower carboniferous age, and on the north side of the river opposite, in close connection with an igneous dyke is the continuation of the Blanchard strata, middle silurian, having lower carboniferous limestone in contact, I have no doubt whatever that there is a connection of the strata of the north and south areas of fossiliferous rocks under the bed of the river. The extension of the igneous rocks observed on the road to the Iron ore, No. 3, would occupy the obscure interval in the brook between the two sets of strata forming a *complete anticlinal* instead of the apparent monoclinal.

All this seems sufficient to determine the approximate age of the strata containing Iron ore, No. 3. This is consequently indicated on the map as middle silurian, which may be called the "upper series of the Cobequids." Geologists have had to call in the aid of the iron divisions of section No. 2 of our map, and to regard the former as devonian, upper or middle silurian, according to the views entertained regarding the age of the latter.

PALÆONTOLOGY OF THE REGION MAPPED.

The sign ff is of frequent, occurrence on the map, in A, B, B', C, D of the "Upper Arisaig series" having fossils, that belong

1st to the Middle Silurian period.

2nd to the Upper Silurian period.

3rd We have ff occurring in limestones of the Lower Carboniferous period.

4th In the south and north side of the coal measure polygon.

I shall briefly collate and examine the Middle and Upper Silurian Faunas; and then examine the fauna of the Carboniferous period.

Regarding the Silurian series of the Springville division of section ten as representative of the Typical series. I shall group the scattered fauna around its members. Our passage will thus be direct into the lower and into the middle carboniferous age.

FOSSILS OF A. FROM THE PICTOU AND ANTIGONISH COUNTY LINE AND DIVISIONS OF SECTION 1.

Nos. 1, 2, 3 and Sutherland's river.

Coelenterata.

Petraia forresteri.

Petraia, sp.

Annuloida.

Crinoidea.

Annulosa.

Cornulites.

Cornulites, trumpet shaped., Salter M. S.

Trilobita.

Calymene, sp.

Molluscoida.

Brachiopoda.

Strophomena corrugata.

Orthis, *species.*

Athyris, species.

Spirifer, like striatus

Spirifer, sp.

Rhynchonella, sp.

Lingulæ.

Mollusca.

Gasteropoda.

Cyclonema.

FOSSILS B.

Section No. 1. Division No. 1 & 3.

Lingulæ of several species chiefly in nodules.

FOSSILS B'.

Section No. 2. Div. No. A, Springville and e Blanchard

Sect. No. 1. Division No. 3, 6.

Coelenterata.

Graptolithus.

Graptolithus clintonensis, (priodon).

Crinoidea.

Cornulites.

Tentacultes.

Crustacea.
Beyrichia.
Trilobites.
Homalonotus Siluriæ Principis.
Dalmanites, several species.
Molluscoida.
Brachiopoda.
Strophomena depressa, abundant.
Leptæna, sp.
Orthis elegantula, abundant.
Leptocœlia intermedia, abundant.
Spirifer, sp.
Lingulæ, species large.
Lingulæ, sp. small.
Discina, sp. large.
do. sp. intermediate.
do. sp. small.
Mollusca.
Cephalopoda.
Orthoceras, small.
Conularia.
Incertae sedis.

FAUNA OF C. SPRINGVILLE.

Mollusca.

Cephalopoda.

Orthoceras *large*
Orthoceras, sp.
Orthoceras, sp.

Molluscoida.

Brachiopoda.

Strophomena, sp.
Strophomena, sp.
Strophomena, sp.
Strophomena, sp.
Rhynchonella saffordi, abundant.
Rhynchonella wilsoni.
Rhynchonella, sp. abundant.

Rhynchonella, sp.
Meristella didyma, abundant.
Atypa reticularis, coarse.
Spirifer crispus ?
Crania, sp.
Crustacea.
Trilobita.
Calymene blumenbachi.
Homalonotus salteri.
Sutherland's river in boulders,
Homalonotus Salteri.
Crinoidea.
Cornulites, large species.

Coelenterata.

Favosites fibrosa.
Stenopora.

Mollusca.

Cephalopoda.
Ascoceras.
Ormoceras, sp.
Orthoceras, sp.
Heteropoda.
Bellerophon, trilobatus.
Gasteropoda.
Holopoea.
Pleurotomaria.
Acroculia haliotis.
Lamellibranchiata.
Clidophori.
Avicula honeymani.
Modiolopsis.
Brachiopoda.
Spirifer subsulatus.
Chonetus, nova scotica.
Crania acadiensis.
Rhynchonella, various.
Discina, sp ?

Crustacea.
Calymene blumenbachii.
Homalonotus dawsoni.
Dalmania logani.
Phacops stokesii ?
Proetus stokesii ?
Entomostraca.
Beyrichia.
Crinoidea.
Cornulites flexuous.
Tentaculites.

The greater part of the organisms of D Springville are identical with those of D Arisaig. Still only a very small proportion of the species in the type have yet been found here. The same may be said of C, the other Upper Silurian member of the "Upper Arisaig series." When I make notes on my new map of Antigonish County this will be made manifest. It is evident however, even from the Springville series, that the fauna of Nova Scotia silurian had in C and D attained their maximum development especially in cephalopoda, pteropoda, heteropoda, gasteropoda, lamellibranchiata, brachiopoda of certain genera trilobites and crinoids. The exceptions are as follows, viz: *Brachiopoda, orthis*, athyris, spirifer, these have their beginning and climax in A, lingulæ in A and B', are rare in B' and very rare in C and D. The trilobite, *dalmanites*, is characteristic of B', *Calymene* is in A, C and D. The graptolithus expires in B'. The pteropod conularia is peculiar to B'. Petraia have their beginning, climax and end in A.

Marine vertebrates do not appear; all are invertebrates. The cephalopoda are of the highest order, and at the same time carnivora of the period.

CARBONIFEROUS (f f.)

The fauna of the Lower carboniferous limestones succeed the Upper Silurian, in the County of Pictou and elsewhere in Nova Scotia as far as is known. This makes a large break in the succession of life. To fill up the gap the Devonian or Old Red Sandstone is required, with its fishes, crustacea, mollusca, &c.

The Carboniferous formation may be seen from the map to come into contact again and again with every member of the Upper Arisaig series, and even with the intrusive rocks that give strike and dip. It is found overlying these strata and intrusive rocks, and overlapping them *a latere* and *a tergo*. The Carboniferous strata in these positions are respectively conglomerates, sandstones, claystones and limestones. These have been formed simultaneously by mechanical and organic agencies, in various conditions of formation. We then have alternations of conditions, and sandstones and claystones are made to succeed limestones, and limestone to succeed sandstone and clays.

The oldest limestone at Springville is that which is in contact with the strata of C. in Holmes' Brook and River. This is as far as seen non-fossiliferous; the next is that of McLean's quarry and Lime brook. Sandstone strata intervene between this and D strata; this is fossiliferous. the fossils are corals of the genus *Lithostrotion*. At Grant's factory on the river are limestones with clayey strata; these are next in order; they have a richer fauna. Others on the river farther down and on the West Branch are also fossiliferous. In the last the *pteropod*, *conularia* is found. This *genus* has already been recognized in B' Clinton of French river.

The collated fauna of the Springville limestones, are:

Localities.	*Cœlenterata.*
	Actinozoa.
Lime brook.	Lithostrotion pictoense.
Factory, E. river.	*Crinoidea.*
	Molluscoida.
	Producta cora.
	do. martini.
Black Teeth.	Spirifer, sp.
	Lamellibranchiata.
Factory.	Nucula?
	Gasteropoda.
	Genus?
	Heteropoda.
	Bellerophon decussatus.

Pteropoda.
Conularia.
W. B., E. River. *Cephalopoda.*
Orthoceras.
Pisces.
Cochliodus sp. Salter.

In my London Exhibition collection, Mr. Salter recognized two teeth of Cochliodas. I was puzzled to know what they were. He at the same time detected specimens of *Bellerophon decussatus.* I believe this is the first recognition of Fishes of so early date in Nova Scotia, and the first identification of *Bellerophon* in the Lower Carboniferous Limestone.

The Silurian Fauna have totally disappeared. As far as Nova Scotia is concerned, this is no great marvel, when we consider the character of the agencies that were at work during the lapse of the Devonian Period, and their stupendous operations. Thus and then Nova Scotia became largely subærial, had its form well defined, and its mountain systems established. Its coasts presented to the seas of the Lower Carboniferous period rock arrangements to a large extent corresponding with those now existing. Hence we have the carboniferous rocks directly on Archæan, Cambrian and Silurian systems, just as the marine accumulations of shingle, sand, clay, dead shells, and their debris now rest, or are in process of formation. We should take this into account, as explanatory of rock arrangements which are readily by some referred to fault occurrence. Faults there are of course, and enough of them, without an unnecessary multiplying of their number.

The conditions of the Carboniferous Period were greatly different from those of the Periods preceding, the character of life differed in accordance. The preceding were invertebrate, now it is vertebrate, Cephalopoda are rare, reptiles appear, fishes became associated with such as do occur, to regulate the number of the mollusca that now begin to exist, increase and multiply.

The Cochliodus of Springville is akin to the Port Jackson Shark, which is also a cochliodont. The Cochliodus is palatal, forming a mouth pavement adapted to the grinding of molluscoida

or molluscan shells. The Cochliodus of East River does not seem to have been a large species; the teeth are not over a half of an inch in size. Our Cochliodus seems to have been an approximate cotemporary of the *Gyracanthus magnificus* of Cape Breton. A formidable and predaceous race of fishes, that pervaded the Nova Scotia seas of the Lower Carboniferous Period. Whence they came we are unable to discover. The Ichthyodorulite of Cape Breton in the Provincial Museum is regarded as unique; its length is about 22 inches, it is stout in proportion.

MIDDLE CARBONIFEROUS.

The last fauna is found in the coal formation polygon.

The localites are:

1. Turnbull's mine, McLellan's Brook.
2. Deacon McKenzie mine, New Glasgow.
3. Crown Pottery mine, New Glasgow.

At 1 and 2 I found, a number of years ago, a number of teeth of Diplodus. They are so-called from their form which is double, one lanceolate is upright the other is recurved, both are crenulated. The root has a heart-shaped prominence on its front. They belong to fishes of the shark family (Hybodont).

The localities where I found them are situate on the south and north sides of the area; from No. 3 mine I received about the same time from a miner the cast of a tooth of large size, with its owner a Holoptychius.

The teeth of Diplodus are of various sizes, showing a graduation as in the mouth of the shark. Associated with these, at MacKay mine were large and small ganoid scales and beautifully striated spines. The late Professor John Phillip of Oxford, seeing these specimens in my London Exhibition collection of 1862, remarked upon the coincidence between the Nova Scotian and British *faunas* in both having *diplodus*. He also observed that the N. S. teeth were much larger than the British. I would refer to another coincidence; the late Professor How of Windsor, N. S. had just discovered a trilobite in the Lower Carboniferous limestones of Kennetcook, N. S. and forwarded me a specimen for identification. I showed it to Professor Phillips as his *namesake* (Phillipsia Howi; Billings). He also remarked upon the

coincidence of the N. S. Carboniferous faunas with that of the mountain limestone of G. B.

We have thus examined the *marine fauna* of the formations of Pictou County, and found an interesting and beautiful succession of life, with only one serious break, from, the Mayhill Sandstone, Intermediate Silurian—of Salter, to the Middle Carboniferous—Coal measures, i. e.

Beginning with Upper Arisaig A. Mayhill Sandstone, or the possible equivalent of the Medina Sandstone, U. S., we have proceeded upwards through B Arisaig, where equivalence (British or American) is doubtful; then B' Arisaig (which is considered by Hall as of Clinton Age, U. S.) next we have passed through the C. Arisaig Aymestry Limestone, (according to Salter) Upper Silurian; then the Upper Ludlow (Salter) or the Lower Helderberg and "Upper Arisaig" of Acadian Geology. We have bridged the Devonian Gap succeeding, and passed through the Lower Carboniferous into the Middle.

APPENDIX.

Nova Scotian Archæology.

Ancient Pottery.

At a meeting of the Institute December 8th, 1879, attention was directed to specimens of supposed ancient pottery, belonging to the Provincial Museum.

Dr. J. B. Gilpin at my request brought the subject before the Institute.

He agreed with me in regarding the specimens referred to as of pottery of a rude and *very ancient character.*

The first specimen of our collection, when brought to the Museum was in fragments. When restored, its singular character and construction rendered it interesting and perplexing. The bottom is a piece of quartzite, flat and subcircular. This is the basis on which the rest is formed. The other material is a sort of clay. The whole is symmetrical and saucer-shaped. The interior is banded concentric. The outside is plain but not smooth. There are now 27 specimens in the Museum, all with one exception——a small one——have stone bottoms. The stones are quartzites and argillites. Their several shapes generally conform to the stones selected for the bases. Their structure is uniform. They are altogether different from specimens of ancient pottery which have been found by Judge Desbrisay in Lunenburg County, and the Rev. Dr. Patterson in Pictou County, associated with stone implements, and have every appearance of greater antiquity.

Mr. J. T. Bulmer, the Librarian of the Legislative and Historical Library, on a recent visit to the Public Museums of the United States, after a search for corresponding pottery, found 3 specimens in the Museum of the Smithsonian Institution at Washington. These are believed to be productions of the Esquimaux.

Our *large find* in Nova Scotia, of which our 27 specimens is only considered to be a representation, thus tends strongly to

confirm the opinion of archæologists, such as Mr. Robert Morrow, who has long maintained that the Esquimaux inhabited Nova Scotia in the 10th or 11th century.

D. HONEYMAN,
Curator of the Provincial Museum.

Halifax, Oct. 14, 1880.

BRIDGEWATER, Decr. 6, 1879.

DEAR SIR,

I received by to-night's mail your card asking for a few notes on the finding of pottery, of which I sent you specimens.

In July 1877, I heard that Indians had found pieces of pottery by the "La Have," not far from this Village, where people of their race had an encampment in early times. I went to the place with one Venall, who told me that having found an arrow head near the surface, he, and other Indians had removed the ground and discovered pottery. We searched and found arrow heads and pottery, nearly all at a depth of two feet and more. One of the pieces I retained, has a round foot, as if originally part of the bottom of a pan or vessel. Another has a round hole, through which a string may have passed for carrying or hanging up the vessel. The pieces are of varying thickness, and differ in the making or designs. In some the latter appear as if made with a finger nail, in others with a stick. The marks on the upper edge, or what was the top of the vessel, are in some as if made with a round-edged stick, while others have marks like tally notches and close together.

M. D. DESBRISAY.

Rev. Dr. Honeyman.

APPENDIX TO NOTES ON THE BONES OF S. SALAR.

Plate 1.—Skeleton of Salmon from Labrador, showing left side. Length of Fish 35½ inches from end of snout, when the jaws were closed, to the centre of the caudal fin. The shoulder girdle and pectoral fin, together with the ventral fin, saddle bone, and

part of the 9th, 10th and 11th dorsal short caudal fin-rays removed.

Plate 2.—Skeleton of young S. Salar, left side, hatched at the Breeding Establishment, Bedford, near Halifax. Length of fish from end of snout to the centre of the caudal fin $21\frac{9}{16}$ inches. Right shoulder-girdle and pectoral fin remaining, ventral fins removed. A marked fish, part of the three first dorsal fin-rays having been cut off. Muscular fibres of the anterior attachment of the anal fin to the general structure remaining.

Plate 3, page 162.—Interspinous bones. The third interspinous bone was broken off in handling, and, unfortunately, lost.

Plate 4, pages 162, 163, 172 to 174.—Dorsal fin and interspinous fin-bones.

Plate 5, pages 166 to 168, 176 to 178.—Anal fin and interspinous fin-bones.

Plate 6, pages 163, 164, 169 to 171, 174 to 176.—Showing caudal fin, saddle bone, hypural bones, bone with cup-shaped dorsal extremity. The saddle bone is removed to show the three (I find this to be the number in another fish from Labrador) representative rays, and is shown in this plate above the place it occupies in the fish.

Plate 7, pages 179 to 183.—Left side, upper, or dorsal aspect.

Fig. 1.—Pelvic bone, with part of right pelvic bone.

Fig. 2.—Ventral Fin.

Fig. 5.—Ventral appendage, with ligaments to left.

Fig. 4.—Ventral fins from young Salmon,—lower or ventral aspect.

Fig. 3.—Ventral fins Codfish—upper or dorsal aspect.

Plate 8, pages 183 to 187.—Left shoulder girdle, outer side.

Fig. 1.—Supra-clavicle.

Fig. 2.—Inter-clavicle.

Fig 3.—Clavicle.

Fig. 4.—Pectoral fin.

Fig 5.—Urohyal bone. In the plate this bone is rather close to the clavicle, owing to the shrinking of the integument.

Plate 9, pages 183 to 187.—Left shoulder girdle, inner side, numbered as plate 8.

Plate 10, pages, 183, 184.

Fig. 1.—Bones from Codfish, (outer side) corresponding to figures 1 and 2, plates 8 and 9.

Fig. 2.—Remainder of shoulder girdle, Codfish—outer side—lower part of accessory bone, page 185, showing to the left of "2."

Fig. 3.—Codfish—Pectoral fin.

Fig. 4.—From a Salmon, left side—same fish as plate 11.

a. Shows where spinal chord (myelon) divides.

b. The notochord where it passes out between the Y shaped bones.

c. Branch of spinal chord (myelon) lying upon the notochord.

d. End of the notochord.

e. Bone,—one of a pair between which the notochord passes, and by which it is protected—the anterior end supported on a pin, the posterior end is attached by fascia to the notochord. This pair of bones are of curved, irregular shape.

Below *e* is the short, irregularly shaped bone (also one of a pair) mentioned on page 164, the posterior end (right hand in plate) is attached by fascia to the anterior end of *e*; when these bones are in their proper position, they protect each side of the notochord, nearly to its extremity.

f. The nervous corpuscle.

In the centre of fig. 4, the pulsating? sack is shown; the outer surface being turned upwards, and marked by a wire loop.

Plate 11.—Shows the right side of the caudal fin of a Salmon. The dorsal spinous rays are removed to show the spinal chord (myelon). One hypural bone, and part of the central caudal rays removed to expose the nervous corpuscle and part of cartilaginous rim (page 169). One long and two short fin-rays laid transversely, to show notochord.—*See end of this Appendix.*

Plate 12, page 179 to 183.—Left side.

Fig. 1.—Left pelvic bone, with part of right; lower or ventral aspect.

Fig. 2.—Left ventral fin, ventral appendage and ligaments.

Fig. 3.—Ventral fins, Codfish; lower or ventral aspect.

Fig. 4.—Ventral fins from young Salmon—upper or dorsal aspect.

Fig. 5.—Left of *5* is the small or superior Y shaped bone. Right of *5* is the larger or inferior Y shaped bone.

Fig. 6.—Left of *6* is the short bone (one of a pair) page 164. Right of *6* is the bone *e*, plate 10, page 175.—[Figs. 5 and 6 are from same fish as plate 11.]

In order to make plate 11 more clear, I have to add:

The spinal chord (myelon) passes upon the dorsal aspect of the centra, covered by a very strong sheath, which lies between the ventral extremities of the dorsal spinous rays until it reaches the end of the vertebræ, it there divides into two principal filaments which are inclosed in a wire at the anterior extremity of the upper or small Y shaped bone. One of these filaments lies upon the notochord, following it to its extremity, where it becomes minutely divided and lost in the general structure. The second or posterior dorsal wire, incloses the notochordal branch; the other I have not attempted to follow.

The notochord passes from the posterior edge of the spongy centrum (page 170) between the forks of two Y shaped bones, lying upon the upper edge of the superior and shorter one, and extends following the curve of the dorsal long fin ray at its superior edge, being overlapped by the longest of the short fin rays (in this specimen 2 inches in length) next to the long fin ray, a distance of $1\frac{1}{16}$ inches. The centre of the notochord being exactly half an inch from the dorsal edge of the caudal fin, where in plate 11 it is marked by a wire. The notochord where it issues from the forks of the superior Y shaped bone, in this specimen is nearly $\frac{1}{8}$ of an inch in diameter, decreasing a little in size until near its extremity, where it is slightly enlarged and has a somewhat blunt rounded termination; it is jointed in structure or rather shows the divisions which in the body of the fish form the centra.

The wire loop nearly in a line with the centre of the spinal column, plate 11, incloses the nervous corpuscle (page 170,) which receives filaments from a ganglion by a branch from the spinal chord.

On the left side of the tail, plate 10, figure 4, is shown the orifices of the pulsating? sack (page 170); the outer part of the

sack being turned up and marked by a wire. This sack is supplied by the vessel which passes through the orifices of the cup shaped bone mentioned on page 169.

Figure 4, plate 10, plate 11 as well as figures 5 and 6, plate 12 are taken from one fish, but not the fish from which my notes have been made and represented in the other plates. Between the bones protecting the notochord in these specimens, I find the following difference: in those of plate 1 the anterior bone (page 164) did not touch the posterior bone (page 175) but was separate some distance from it, the space between them being occupied by fascia; and the posterior bone was much shorter in proportion and much more strongly curved than that of the fish represented in plate 11.

The Artotypes illustrating this paper, are the work of Mr. W. D. O'Donnell, to whom the writer is much indebted for the care which he has bestowed upon them.

Dr. Sommers presented a specimen of Trillium sessile, collected by Miss Godfrey, of Clementsport, Digby County; he believed it was the first recorded instance of finding of the species in our Province. Trillium cerectum, T. erythrocarpum grows abundantly in many localities. T. cernuum not so frequent, and now Miss Godfrey has the honor of adding a fourth to the species of Trillium growing with us.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART 3.

Dalhousie College, Oct. 13, 1880.

ANNIVERSARY MEETING.

JOHN SOMERS, M. D., *Vice-President, in the chair.*

The SECRETARY reported that the Council had elected Vice-Admiral Sir LEOPOLD MCCLINTOCK, Knt., F. R. S., &c., a Corresponding Member.

A letter was read by the PRESIDENT, WM. GOSSIP, F. R. M. S., in which he thanked the Institute for electing him to the office of President at the last anniversary meeting, and expressing a desire to retire from that office.

The following were then elected Officers:—

President—JOHN SOMERS, M. D., F. R. M. S.

Vice-Presidents—ROBT. MORROW, GEORGE LAWSON, PH. D., LL. D., F. I. C.

Treasurer—W. C. SILVER.

Secretaries—Prof. D. HONEYMAN, D. C. L., F. S. A., and J. T. MELLISH, A. M.

Council—J. B. GILPIN, M. D., WM. GOSSIP, HON. L. G. POWER, J. M. JONES, F. L. S., AUGUSTUS ALLISON, W. SAWERS STIRLING, ALEX. MCKAY, M. MURPHY, C. E.

ORDINARY MEETING, Dalhousie College, Nov. 8, 1880.

The PRESIDENT *in the Chair.*

It was intimated that Lieut.-Col. PRICE LEWIS had been elected a Member, by the Council.

The PRESIDENT made appropriate observations on the work of the Institute.

DR. HONEYMAN then read a paper "On the Geology of Digby and Yarmouth Counties." The paper was illustrated by a large map and a collection of specimens.

ORDINARY MEETING, Dalhousie College, Dec. 10, 1880.

ROBT. MORROW, VICE-PRESIDENT, *in the Chair.*

The PRESIDENT, DR. SOMERS, read a paper "On Fungi of Nova Scotia." It was illustrated by a large collection of dried Fungi.

ORDINARY MEETING, Dalhousie College, Jan. 17, 1881.

The PRESIDENT *in the Chair.*

"Notes on the occurrence of Lievrite in Nova Scotia" were read by E. GILPIN, M. E., F. G. S.

DR. J. B. GILPIN read a paper "On the Rapacious Birds of Nova Scotia."

ORDINARY MEETING, Dalhousie College, Feb. 14, 1881.

ROBT. MORROW, *Vice-President, in the Chair.*

DR. SOMERS, the PRESIDENT, gave the substance of a paper "On Nova Scotian Mosses." The paper was illustrated by a large number of specimens from different parts of the Province, and microscopic preparations.

DR. GILPIN made observations upon three fishes from the Provincial Museum, which were considered to be new to Nova Scotia.

ORDINARY MEETING, Dalhousie College, March 14, 1881.

The PRESIDENT *in the Chair.*

It was announced that SIMON MACDONALD had been duly elected a Member, by the Council.

Also that THOMAS G. STEARNS, of Nictaux, had been elected an associate member.

DR. HONEYMAN then read a paper "On the Geological Formations of the Cobequid Mountains."

The paper was illustrated by specimens and "A Geological Progress Map," which had been exhibited by the author at the Centennial Exhibition of Philadelphia, 1876. The map contains additional observations by the author, also reductions of the maps of the Geological Survey of Canada.

ORDINARY MEETING, Dalhousie College, April 11, 1881.

The PRESIDENT *in the Chair.*

DR. GILPIN read a paper "On the Dwellings of the Beaver and Muskrat." The paper was illustrated by sketches from nature by the author.

ORDINARY MEETING, Dalhousie College, May 9, 1881.

The PRESIDENT *in the Chair.*

A paper "On the Ice Storm of Jan. 24, 1881," by H. S. POOLE, F. G. S., was read by Augustus Allison.

A paper "On the Lichens of Nova Scotia," by A. H. MACKAY, B. A., B. Sc., was read by the PRESIDENT.

Notes "On the Geology of Point Pleasant," by A. G. CAMERON, and

Notes "On the Geology of Bedford, Sackville and Hammond's Plains," by ALFRED HARE, were read by Dr. HONEYMAN.

These two papers were illustrated by maps.

LIST OF MEMBERS.

Date of Admission:

1873. Jan. 11. Akin, T. B., D.C.L., Halifax.
69. Feb. 15. Allison, Augustus, Meteorologist, Halifax.
77. Dec. 10. Bayne, Herbert E., Ph. D., Professor of Chemistry, Royal Military College, Kingston.
64. April 3. Bell, Joseph, High Sheriff, Halifax.
64. Nov. 7. Brown, C. E., Halifax
78. Nov. 11. Cockburn, Colonel, R. A.
67. Sept. 10. Cogswell, A. C., D.D.S., Halifax.
72. April 12. Costley, John, Deputy Prov. Secretary, Halifax.
63. May 13. Cramp, Rev. Dr., Wolfville.
75. Jan. 11. Dewar, Andrew, Architect, Halifax.
63. Oct. 26. DeWolfe, James R., M.D., L.R.C.S.E.
63. Dec. 7. Downs, Andrew, Cor. Memb. Z. S., London, Halifax.
73. April 11. Gilpin, Edwin, F.G.S., Govt. Inspector of Mines, Halifax.
60. Jan. 5. Gilpin, J. Bernard, M.D., M.R.C.S.L., Halifax.
63. Feb. 5. Gossip, William, Halifax.
63. June 17. Hill, Hon. P. C., Barrister-at-Law, Halifax.
66. Dec. 3. Honeyman, Rev. David, D.C.L., F.S.A., &c., *Secretary*, Curator of Provincial Museum, and Professor of Geology and Palæontology, Dalhousie College, Halifax.
74. Dec. 10. Jack, Peter, Cashier of People's Bank, Halifax.
79. Jan. 11. James, Alex., Judge of Supreme Court, Halifax.
63. Jan. 5. Jones, J. M., F.L.S., Halifax.
64. Mar. 7. Lawson, George, Ph. D., LL.D., F.C.I., *Vice-President*, Professor of Chemistry and Mineralogy, Dalhousie College.
81. Mar. 14. Macdonald, Simon, Halifax.
75. Jan. 11. Mellish, John T., M.A., *Secretary*, Halifax.
72. Feb. 5. McKay, Alexander, High School, Halifax.
77. Jan. 13. Morrow, Geoffrey, Halifax.
72. Feb. 13. Morrow, Robert, *Vice-President*, Halifax.
70. Jan. 10. Murphy, Martin, C. E., Provincial Engineer, Halifax.
65. Aug. 29. Nova Scotia, the Rt. Rev. Hibbert Binney, Lord Bishop of
79. Nov. 11. Poole, H. S., Assoc. R. S. M., F. G. S., Superintendent of Acadia Mines, Pictou.
76. Jan. 20. Power, Hon. L. G., Senator.
71. Nov. 19. Reid, A. P., M.D., Sup't. of Prov. Lunatic Asylum, Dartmouth.
5. Jan. 8. Rutherford, Jas., M.E., Halifax.

Date of Admission:

64. May 7. Silver, W. C., *Treasurer*, Halifax.
75. Jan. 11. Somers, John, M.D., F.R.M.S., *President*, Prof. of Physiology and Zoology in the Medical College of Halifax.
74. Ap'l. 11. W. S. Stirling, Cashier Union Bank, Halifax.
79. Feb. 10. Twining, Chas. F., C. E., Halifax.
66. Mar. 18. Young, Hon. Sir William, Knt., late Chief Justice of Nova Scotia.
77. Jan. 13. MacGregor, J. G., A.M., D. Sc., F.R.S.E., Prof. of Physics, Dalhousie College, Halifax.

ASSOCIATE MEMBERS.

63. Oct. 6. Ambrose, Rev. John, M.A., Digby.
77. May 14. Burwash, Rev. J., A.M., Professor of Chemistry, Wesleyan College, Sackville, New Brunswick.
78. Feb. 11. Louis, Henry, Assoc. R.S.M., London.
71. Jan. 11. McKay, A. H., B.A., B. Sc., Principal of Pictou Academy.
65. Dec. 8. Morton, Rev. John, Missionary of the Presbyterian Church of Canada, Trinidad.
76. Mar. 13. Patterson, Rev. George, D.D., New Glasgow.
81. Mar. 14. Stearns, T. G. (of New York), Middleton, N. S.
80. May 10. Walker, Jas., M.D., St. John, N. B.

CORRESPONDING MEMBERS.

71. Nov. 29. Ball, Rev. E., Maccan.
68. Nov. 25. Bethune, Rev. J. S., Ontario.
76. Dec. 11. DeWolf, Dr., Tintern, England.
70. Oct. 17. Harvey, Rev. Moses, St. John's, Newfoundland.
71. Oct. 11. Marcou, Jules, Cambridge, Mass.
80. June 10. McClintock, Sir Leopold, Knt., F.R.S., &c., Vice-Admiral.
77. May 14. Weston, Thomas C., Geological Survey of Canada.

LIFE MEMBER.

Hon. Dr. Parker, M.L.C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I. — NOVA SCOTIAN GEOLOGY. — DIGBY AND YARMOUTH COUNTIES.—REV. D. HONEYMAN, D. C. L., F. S. A., &c., *Curator of the Provincial Museum and Professor of Geology and Palæontology in Dalhousie College and University.*

(*Read Nov.* 8, 1880.)

INTRODUCTION.

As the investigation of the Geology of the Counties of Digby and Yarmouth is an extension of the work already done in the Counties of King's and Annapolis, I deemed it advisable, as I found it convenient, to take a second look at the fossiliferous rocks lying between Moose River and Bear River.

IRON MINE.

The Rev. Mr. Godfrey and I revisited the Iron Mine of Moose River, sometimes called the New Iron Mine. The ore here is *Magnetyte.* Its fossils, especially the gigantic trilobite *Asaphus ditmarsiæ,* and those of the associate strata are considered to be unquestionable evidence of Pre-Devonian and Pre-Upper Silurian and therefore Middle Silurian age. *Vide Transactions, 1878-9-80.* Here, as formerly, I collected fossils, e. g., additional specimens of the Cyathophylloid coral. *Petraia sp?* South of these mines and of the Hessian Line (road) fossiliferous *quartzites* were previously observed, apparently lying next to the Archæan Granites. These are considered to be an extension of fossiliferous

rocks at Bear River, on the north side of the bridge. The latter are seen to be synclinal to the extension of the iron mine strata at Bear River. *Trans. 1879-80.*

Greenland.

South of the "Old Mine" (Milner's) the Greenland road branches off the Hessian Line road. Traversing the former we descend and then ascend a ridge having outcropping strata, Here there is abundance of fossils, but the metamorphism and extreme hardness of the rock interfered materially with the collecting of fossils, so that no remarkable forms were secured. These are undoubtedly passage rocks of the Bear River and Moose River sections, already referred to. Crossing the strata of the ridge, we reached Greenland. This Greenland is a settlement evidently overlying granites. The analogy of the Moose River section, the soil and the abounding granite boulders scattered on the fields and on the surface of the ground as far as the eye can reach, are sufficiently convincing. Proceeding westward through the settlement toward Bear River, nothing was observed but granite masses. Turning northward we crossed 1st fossiliferous strata, the extension of Rice Mill strata, Bear River W, or of the Moose River quartzite E, and of Greenland road crossed on the way to Greenland. 2nd, A great and interesting exposure of strata which I noticed in my paper of last session as occurring on both sides of Bear River (Annapolis and Digby). These and the first met on this road are synclinal to the continuation of the New Mines' strata already noticed. The second or upper outcrop produced specimens of *Petraia sp*, similar to that of the New Mines. These, therefore, may be regarded as of the same age as the *Asaphus ditmarsiæ* strata (middle silurian). The latter succeeds the Archæan granites.

Bear River.

Proceeding up the river (south) on the Annapolis side, we recrossed the fossiliferous strata, already crossed and recrossed, until we came in front of Rice's Mill. Crossing the bridge over to the Digby side of the river, I re-examined the massive quartzose rocks at Rice's Mill but did not succeed in securing any well

marked fossils from them. The rocks are only exposed in a section, being otherwise covered with soil. Their dip is nearly vertical; their strike E. and W. Between Rice's Mill and Bear River village, on the Digby side of the river, the only exposure of strata found is at a ship yard. These, like the strata on the Annapolis side of the river, are of Middle Silurian age.

The next outcrop is on the north side of the village, and of the syncline. Here we have the western extension of the strata of the New Mines, with an intrusive *diorite*. These were particularly noticed in my Paper of last session.—*Trans.* Keeping to the same side of the river and proceeding northward, I did not observe any rock exposures until we came to the hill opposite the great quartzite on the other side of the river. This quartzite is succeeded by slates having fossils, which were considered to be of the same age as *Asaphus ditmarsiæ—loc. cit.* (middle silurian). The quartzite is not distinguishable from Bogart's quartzite, and might claim the specimen which has the fossils—*Arthrostauros Godfreyi* and *Maclurea sp.* The strata on the hill exposed by several outcrops, may be considered to be a continuation of those on the opposite side just referred to, and, consequently, to be of the same age (Lower Silurian). Still farther on we meet with other outcrops of strata, corresponding with those on the other side, and then come to the Victoria Bridge, Digby road.

I examined the fine section of rocks below the bridge, on the Digby side of the river and towards its mouth. I found the rocks to be quartzites of enormous thickness and diorite of great width. I consider the quartzite to be, like the quartzite already referred to, of Lower Silurian age, and the diorites as intrusive rocks of Devonian age. We found the *diorite* outcropping to a distance of three miles, towards Digby. Another set of strata was observed at our turning point. These also appear at the bridge near Digby. They lie on the north of the *Diorite.*

Digby and Yarmouth Railway.

Jordan Station.

The first appearance of Silurian rocks on the railway occurs near the Jordan station—black shales appear in a small cutting.

North Range Station.

Abundance of quartzite and diorite masses were observed on the sides of the railway. These led me to infer that the quartzites and diorites of Victoria Bridge extend thus far and pass onward.

Weymouth.

About a mile short of the station a cutting of rocks appears. They seem to be quartzites of which there are considerable exposures to the left, which I subsequently examined. Thus far the examination was rather cursory. It was evident that the rocks are an extension of the Moose and Bear River formations. The course of the railway being to a large extent in the general strike of the rocks, only a comparatively small width of the series was crossed, consequently little variety occurred.

From Weymouth onward to Yarmouth I had an excellent opportunity of making a satisfactory examination of any exposures that occur on or near the line of railway. Through the kindness of Mr. Murphy, Government Engineer, and Mr. Murphy, contractor, I made an examination by *trawley*.

Between Weymouth and Church Point we passed through three cuttings of slates and quartzites on three several grades.

Meteghan Station.

Here and about a mile beyond are cuttings of slates still belonging to the series which I regard as Middle and Lower Silurian. Succeeding are three and a half miles of obscurity, then we came to a fine cutting, having the rocks bold on either side of the road. This is the familiar quartzite of our Halifax metamorphic rocks. Its associate on the north side is a fine micaceous argillite. The obscure interval occurring between this and the Meteghan slates is disappointing. I had anticipated a more satisfactory state of things in my railway examination. Believing that the granites did not extend thus far westward, I had expected that the railway would reveal some approach to a junction of the two grand series of metamorphic stratified rocks with manifest conformability or unconformability.

I shall revert to this subject.

Proceeding onwards we crossed the county line (Digby and Yarmouth) coming to Salmon River and Lake Annis, without observing anything remarkable. Near Four Mile Lake a cutting showed that we had passed from quartzites into coarse mica schists. Masses show the micaceous character of the underlying rocks. They also show *garnets* and *staurolites.* After this masses of quartz were observed indicating a vein or veins of considerable thickness. At Ohio and Hebron rocks were observed and specimens secured. The rocks are more or less hornblendic. This is their character onward to Yarmouth.

METEGHAN.

On the day following I returned by railway to Meteghan station, for the purpose of investigating the *transition* between the formations already noticed, supposing that there might be a section on the shore which might aid in filling up the gap made by the 3½ miles of obscurity already referred to. Proceeding to Meteghan I crossed a branch of Meteghan River, where bold exposures of the station strata were observed in a position not particularly inviting. Their extension was found near Meteghan Point on the shore, exposed in a manner that left nothing to be desired. On the south side of this point is a cove, Turk's Cove. Here the rocks are seen in great magnificence. There is an outer and an inner band. The one is much harder and more resisting than the other. Of the former the two points of the cove are formed. The north side of the cove has been penetrated by the sea, and a cave has been formed which is said to extend over two hundred feet. This is constantly occupied by the sea. I searched in both bands of rocks for fossils without success. They are highly metamorphic and contain numerous quartz veins. These bands continue exposed along the shore toward Cape St. Mary's, making a rugged coast with numerous coves of character similar to that already described. The same strata were also frequently observed, exposed on the road side. I did not follow the rock exposures on the shore beyond two or three miles. I took a short cut to Cape St. Mary's by following the road to Cape Cove.

The first rock met with of decided character, on the Railway,

after leaving the diorites of North Range, was the grey quartzite which followed the obscurity, on which I am now endeavouring to throw some light. Beyond adding a certain *quota* to the filling up of the gap of rocks, of a like undecided character, the Meteghan section did little additional service. The lithological character of the rocks is so different from that of Moose and Bear River rocks, that the two, when viewed separate, might be regarded as belonging to different series and different periods.

My observations at Moose and Bear Rivers led me to forecast the occurrence of rocks of corresponding age as far south as Cape Cove, on the coast of St. Mary's Bay, and to regard this as their probable termination. My *hypothetical* line, extending S. 40 W. from the end of Moose River section through the corresponding point on Greenland road, Bear River road and Rice's mill to Cape Cove, also indicated the probable southerly position on the Digby and Yarmouth Railway, in the *obscurity* beyond Meteghan station.

When coming near Cape Cove I was agreeably surprised to meet an old acquaintance, the familiar *diorite* of Nictaux, Moose and Bear River. This *diorite* outcropping boldly on the left side of the road, with a very hard quartzite in contact on its south side, is seen to extend in high elevation eastward (toward the line of railway,) about half a mile. Westward in Cape Cove it is seen exposed, but not so compact as in the west, having a somewhat slaty aspect, yet coarsely crystalline. Here it is seen to occupy the *normal position* as at Nictaux, Moose River and Bear River. The quartzite observed on its south side at the road does not appear at the cove. All the strata exposed are on its north side. There are slates and shales of varying colours, fawn, grey and black. The strike of the strata is S. 70 W., N. 70 E., the dip is vertical. This is precisely as at Nictaux and Moose River where strata occur in contact, or approximately so, with *diorite* e. g., Bloomington Road, Nictaux.

The black slates at the extremity of the cove or Cape St. Mary's are elevated and very picturesque. On the shore below the light house milky quartz is scattered profusely, contrasting with the black slaty *debris*. It is evident that the existence of

Cape St. Mary and Meteghan is dependent upon the resisting power of the diorite. It has been an effective breakwater in the past as it is in Cape Cove at the present. Beyond the cove are flats, swamps and meadows. About a mile from the cove the ground becomes elevated, and black slates are seen outcropping containing veins of white quartz. As seen at Z. Deveu's they are not distinguishable from the black slate of Cape St. Mary with milky quartz already referred to. At this time I was not aware of their true character, I supposed that they *corresponded* with the Cape St. Mary's strata, considering that the two formed an anticlinal having the diorite for its centre. Dr. Selwyn seems to consider the Cape St. Mary's slates as corresponding in age with the black slates of Jebogue Point. In regarding them as corresponding with Deveu's black slates, I was unwittingly and indirectly doing as Dr. Selwyn had done, while I was regarding both as occupying the lowest position in the Middle and Lower Silurian series of Moose and Bear River. On the following day I returned to Yarmouth expecting to resume investigations at Cape Cove, with a view to the further filling up of the railway gap, the extension of the quartzite succeeding not yet having made its appearance on the shore.

Yarmouth.

I have to acknowledge my obligations to the Hon. Loran E. Baker and S. M. Ryerson, Esq., for making arrangements by which I was enabled to make a very satisfactory examination of a considerable extent of the interesting rocks of Yarmouth and Digby in a comparatively short time.

Sunday Point.

This was the first place near Yarmouth that I examined. Mr. Ryerson took me there. The rocks at this point are very interesting, they are Porphyrite and Diorite.

This is the first time that I have seen porphyrites and diorites in our auriferous formation. They have been frequently found in the Archæan and later formations, at Arisaig, the Cobequid Mountains, McLellan's, Sutherland's River Mountains. Diorites

are also of frequent occurrence as noticed in this and preceding papers in our *Middle and Lower Silurian.* They are here pervaded by quartz veins of varying thickness.

They have also abundance of *mica* in their constitution. In this they differ from porphyrites and diorites observed elsewhere. I have no doubt that these, like most others, are igneous rocks, and intrusive if not contemporaneous.

The rocks of Sunday Point have a strike N. E. and S. W. An exposure of these with their numerous veins of quartz N. E from Sunday Point is a reputed gold field.

We also examined outcrops of black quartzose rocks in the cemetery. These have the same strike, N. E. and S. W.

Cranberry Head.

Next day Mr. Ryerson took me to this point to see the gold mines. I examined outcrops of hornblendic rocks on the way. Some of these have been already referred to as occurring at Hebron and Ohio, on the line of Railway, the extension of the rocks of the latter running in this direction.

Before reaching the mine we visited the quartz crushing mill which was undergoing repairs. Large quantities of quartz from the mines were there ready for operations. The mines were found to be interesting. The quartz containing the gold did not appear different from what I had seen elsewhere. The containing rock is decidedly different; it is very soft magnesian (?) slate. *Arsenopyrite* is very abundant in crystals. The quartz is singularly free from this mineral, and the gold is rarely visible. I received from the superintendent of the mines four specimens showing gold very distinctly, associated with *Calchopyrite* and *Galenite.*

Jebogue Point.

Mr. Ryerson next took me to this locality, where I found a very interesting series of rocks, beautifully exposed. I observed

1st. The grey quartzites, compact and shaly with quartz veins. These have a strike N. 30° E., S. 30° W., and a high northerly dip.

2nd. A basaltic dyke compact and amygdaloidal. Of this we have a vertical and a horizontal section. On either side of this dyke the strata are tilted and much contorted. The dyke is parted in the middle. On the sides of this parting the rock is amygdaloidal. The amygdals are of quartz. The rock appears to be a dolerite. On either side between the dyke and the strata is a soft tuff. This crystalline rock is unquestionably of igneous origin, and it is plainly intrusive. The rock has much the appearance of a North Mountain (triassic) trap. I have seen no rock like it elsewhere. *Queries.*—When did this eruption occur? It is evidently an occurrence posterior to the metamorphism of the associate strata. Was the eruption in *pre-middle* or *post*-carboniferous time? Did it happen before the formation of the *Arthrostauros Godfreyi* quartzites and the *Asaphus ditmarsiæ* iron deposit? Did it occur after the metamorphism of the latter by the *dioritic eruptions*, and prior to the formation of the conglomerates and Chester limestones or other deposits of lower carboniferous age, or after, when the auriferous rock and associate lower carboniferous conglomerates quartz and limestones were brought into their present position?

3rd. Grey argillites with quartz veins large and small.

4th. Black argillites, very pyritous with quartz veins, numerous and occasionally of great thickness.

A black substance like impure graphite occurs in the shaly argillites.

5th. A granitoid hornblendic rock with grey shaly argillite on either side.

Returning to Yarmouth we took a road that led us to the Poor House. Here I examined an imposing outcrop of white quartz which had been operated upon by gold hunters. On either side of the quartz, which is thirty feet thick, are black shaly argillites. It is evidently a continuation of one of the great veins which I have already referred to as occurring in the black argillites of Jebogue Point.

Bear River.

The Hon. L. E. Baker took me to Bear River on the following

day. I expected to find this a region of peculiar interest. Here we have the county line of Yarmouth and Digby and the junction of the formations which I am now investigating, according to "Map of Acadian Geology," Ed. 1868.

Passing Cranberry Point I observed an inviting outcrop on the road at "John Cann's Farm," the strike was found to be N. 50 E., S. 50 W. We then proceeded to "High Head" in search of a rock section. Reaching the shore at J. Trask's I found a section extending from High Head to Trask's, a distance of about half a mile. It consists of grey quartzites in ledges with alternating shales. The strike at Trask's is S. 69 W., N. 69 E, dip 45° S., 21 E. As far as I could see beyond this section to the north no other outcrop appears.

On the shore at Bear River there is a magnificent exposure of strata. The rocks are quartzites and schists. The strike is S. 69 W., N. 69 E. North side of the wharves and shipyard an outcrop of micaceous quartzite was reached, and a specimen of the rock secured just before it was covered by the tide.

I supposed, at the time, that this might be the lowest rock of the series, as no outcrops of rocks were visible beyond.

Lake George.

In Yarmouth Mrs. S. M. Ryerson showed me a quantity of beautiful sand, which was supposed to be *amethystine.* On examination I found the sand to consist of myriads of small garnets, a great proportion of which were perfect crystals—rhombic duodecahedrons. It was said to have come from Lake George. Being anxious to see the deposit and ascertain its origin I requested Mr. Baker to return by Lake George. Taking into account the facts that all the strata observed on and towards the shore had a N. E. and S. W. strike, and that the rocks outcropping on and near the line of railway are extensions of the rocks on the shore, I concluded that the micaceous schists found near Four Mile Lake on the line of railway holding quartz and staurotide, which seemed to belong to a band of considerable width, must be the bed rock of the lake and the source of its garnet sand. . . . .

Coming to Lake George I could not find any rocks outcropping. I had therefore to have recourse to stones scattered around and collected into heaps. Among these I found abundance of mica schist stones replete with garnets, generally small like those of the sand that I had seen. Sometimes, however, stones were found having common garnets of large size. One specimen of rock that I picked up is a most beautiful cabinet specimen. In it the garnets are pretty large; one side is light colored and shows the numerous garnets in relief to great advantage; the other side is dark micaceous schist with numerous rubbed garnets.

We called upon Mr. Winter, who is said to be the best informed, relating the place of occurrence of the sand in question. He had a number of barrels filled with the sand, which I examined with interest. According to his account the places on the shore where the sand occurs are increasing in number; none of them are of easy access so that we did not see them.

There can be no doubt that garnetiferous mica schists are the chief rocks of the lake, and that the sand is their debris. The lake is large and is frequently agitated by great storms, so that the *debris* accumulates rapidly. The specific gravity of the garnets is greater than that of the mica or quartz, and therefore the garnets are separated readily from the *debris* and sorted by the action of the water.

Artificial stone has been made with the garnet sand. It is said to be beautiful.

Masses of brownish crypto crystalline quartzite are found scattered about the lake. There are quartz veins in these which are hardly distinguished from the rock. Hornblendic rocks of a peculiar character are also represented by masses. Some of these are very hornblendic, hard and tough; others are horblendic-micaceous-schists, having the crystals of hornblende singularly arranged in stellar and plumose forms.

On our return to Yarmouth we passed over outcrops of rocks of the railway and harbour.

HARBOUR.

I examined the rocks of the harbour, accompanied b

Cowan of Digby Neck. On the way to the light-house I observed outcrops of strata whose strike is in the direction of Cape Point.

Mr. Cowan informed me that these are exposed in a fine section at the point.

Not having an opportunity of examining the said section when with Mr. Cowan, I made a subsequent attempt with Mr. Johns, of the Yarmouth Bank, but did not succeed owing to rainy weather.

The rocks exposed on the road are hornblendic, being identical with the rock masses met with at Lake George. The light-house band which lies on the south of these is a singular schist. It is hornblendic and micaceous on the north side of the harbour; towards the light-house it becomes light green in colour and homogeneous in appearance. The strike of these is N. 35 E., S. 35 W. These rocks are evidently a continuation of rocks seen outcroping toward the line of railway. At the head of the harbour beside the railway station I examined a slaty rock which is soft and fine grained. This is an outcrop of the harbour strata. Specimens of slaty rock, having hornblende beautifully plumose, were brought to me when I was on the point of leaving. Masses pointed out to me as the rocks that produced the specimens, were seen to abound in similar hornblendic figures. These are evidently derived from the Yarmouth underlying strata.

Beaver River to Cape Cove.

Uniting Church's maps of Yarmouth and Digby Counties, I found that there were several miles intervening between Beaver River and Cape Cove which I had not examined; this was by no means satisfactory. Mr. Johns readily offered to aid me in this work. Considering it advisable to resume my former investigations where I had discontinued them, we made direct for Z. Deveu's at Cape Cove. Following the strike of the black argillites, with quartz veins exposed at Deveu's, towards the shore, we found a great section extending southward toward a distant point. Before reaching the point the colour changed from black to grey. I was at once convinced that I had misunderstood the character of Deveu's strata in regarding them as

corresponding with Cape St. Mary's black strata, and as forming an anticline with the latter.

I have before shewed that the strike of the Cape St. Mary black argillites is S. 70 W., N. 70 E., and the dip vertical. The strike of Deveu's argillites, as observed on the shore, is S. 50 W., N. 50 E., and their dip 45° S., 40 W. The latter are very pyritous, cubical crystals occupying the lines of bedding and making beautifully brilliant lines in the sunshine. This is not a characteristic of the black argillites of Cape St. Mary. I have noticed the occurrence of milky quartz in the latter. The pyritous argillites are replete with quartz veins. The black pyritous argillites of Jebogue Point with quartz veins are more nearly analogous. The division between the two great series of rocks is the *diorite* already noticed as intervening between the Cape Cove strata and Deveu's strata. We have thus a division corresponding with the Bloomington Road division at Nictaux, and at Gordon's on the King's County side of Annapolis and King's County line. *Transactions* 1877-8.

While we note this point of resemblance I would also note the following points of difference: At Bloomington Road, Nictaux, the diorite is seen to occupy nearly the entire space between the two formations, there being only a very narrow interval of obscurity between the *diorite* which immediately underlies the fossiliferous strata of the ferriferous on the north and the gneissoid strata at Wheelock's, of the auriferous formation, on the south. At Gordon's, near the New Canaan Road on the King's County side of the county line, the *diorite* has corresponding fossiliferous strata on the north, and only a short distance of obscurity between the diorite and the singularly plicated *gneissoid strata*, of the other formation on the south. In the locality under examination the *diorite* is in immediate contact with the lowest strata of the ferriferous formation in Cape Cove, while there is an obscure interval of one mile between the *diorite* and *Deveu's* black argillites of the auriferous formation.

Carboniferous.

There is yet another point of interest to which I would direct

attention. When I was examining the interval between the cove rocks and the black pyritous argillites, I observed a singular section which occupies a large part of the obscure interval; on the north side of this, next the flats of Cape Cove, the soil is underlaid by a coarse ferruginous gravel. It then becomes more compact, cemented by iron oxide it becomes conglomerate, grit and breccia, arranged in *beach form.* It is then seen overlying unconformably the black pyritous argillites at a considerable height, and with a northerly dip. The greater part of these is derived from the black argillite which supplies rock material and iron cement. A small stream of water flows down the face of the highest part of the section—*chalybeate water.* I recognised the strata of the section as a counterpart of the carboniferous, auriferous, conglomerates and breccias of Gay's River, Colchester County. This section fills up about a third of the interval. How far this formation extends inland cannot be ascertained except by *sinking* or *boring.*

We have thus three formations meeting or nearly so in this locality, which is distant 5 miles from Beaver River and county line. I have thus added to the geological formations of Digby County a carboniferous formation, and 5 miles of auriferous formation.

Salmon River.

Returning we observed an outcrop of grey slates on the road side, about opposite the point on the shore referred to when examining the sections of black slates. Near Salmon River we directed our course to the shore for the purpose of examining the southern extension of the preceding section. Here I was gratified by finding great ledges of rocks, solid grey quartzites having pyrite in large crystals, the exact counterpart of the Bedford Basin quartzites, Halifax County. Towards the point referred to, the quartzites become less solid and are succeeded by grey argillites. These in turn are succeeded by Deveu's black argillites. Considering the grey quartzites with the argillites of the railway section, to be an extension of the shore section grey quartzites and argillites, south of the point south of Cape Cove, it seems to require the grey argillites extending northward beyond the

said point Deveu's black pyritous argillites, the rocks hid in the interval between Deveu's and Cape Cove, and Cape Cove and Cape St. Mary's rocks to a distance of $\frac{3}{4}$ of a mile north of Cape Cove, to fill up the obscure gap on the line of railway. I also examined strata outcropping to the south of the grey quartzites. These are quartzites with interbedded argillites. At the last of these outcrops great masses of basalts were examined. At a distance these appeared as solid. They are only masses transported from Digby Neck, Long Island or Briar Island.

CRANBERRY HEAD.

When I previously visited Cranberry Head gold mines, I was just beginning to make acquaintance with the rocks of the region, and was somewhat perplexed with their singular characteristics. I now wished to examine the gold bearing strata in the light of experience since acquired. Mr. Ryerson readily consented to re-conduct me to the locality.

With a view to connect my observations with those made on the rocks on the north, we went beyond the mines until we reached the end of the outcrops of the Mines' section on the shore, about a mile distant. The first rocks are grey quartzites with interbedded soft argillites. The position, alternation, exposure and general appearance led me to expect *fossils* in them. I soon found a mass of quartzite detached from the strata of the ledges, having on it forms whose resemblance to *stromatopora* is unmistakable. Considering it as interesting I determined to secure it. The size of the stone, the want of assistance and proper tools—Mr. Ryerson had left me to meet at the mines—were difficulties in the way. However, by patience, perseverance and a good hammer, I succeeded in making a portable specimen. The picture in "Geology of Canada, 1866, page 49," might pass for a figure of it, if partly obscured on the top. It is banded; two of the bands amastomose, a large part of the top is obscured as if rubbed or pressed by the overlying rock, outlines of the sub-parallel bands being preserved. The specimen figured by Sir William Logan was compared with *stromatopora rugosa*. It is now known as the *Eozoon canadense*. Our speci-

men strikingly resembles a museum specimen of *stromatopora sp*, from the Niagara limestones of *Baie de Chaleurs*, New Brunswick. The specimen is not a cast. The organism, if it was one, has been replaced by quartzose material so as to preserve the form. The specimen may only represent a certain rock structure; if so it illustrates the possibility of a striking imitation of organic structure being only rock structure. I give the specimen the name *Stromatoporoid, sp.*

Several of the grey quartzite strata which are overlaid by the shaly argillites have had their faces partially exposed. These look so like fossiliferous rocks that I was led to search in them for fossils. I succeeded in finding in one of the quartzite strata peculiar forms which were certainly made by organisms. In shape they are *discoid* and *eliptical*. One specimen which I succeeded in securing is oval with an interior depression. The only thing that can compare with them are roots of *Buthotrephis*—Hall's Palaeontology of New York, vol. 2, plates 7, fig's 2, 6, 10, fig's 9, 10. It is certainly interesting to find such forms in proximity to gold producing *strata*. Proceeding I found next an enormous exposure of crystalline rocks—*diorites*. These are of a character different from the *diorites* of Cape Cove. Like the porphyrite of Sunday Point the *diorite* here is very *micaceous*. Crossing this enormous outcrop of diorites I came to another great exposure of grey quartzites, and reached the Cream-Pot with the auriferous quartz of the gold mine.

CREAM-POT.

Is so called as the sea is said, in violent storms, to fill the recess with froth. This pot is geologically interesting. The strata within succeeding the quartzite last described as reaching to the point, has some resemblance to soap-stone; they are light grey, soft and unctuous argillites. In these the auriferous quartz vein is found. This is beautifully exposed on the side of the Cream-Pot, and can be studied to great advantage. This vein is very peculiar, it swells out and narrows in turns, being in the one case often of considerable thickness, on the other very narrow. The great softness of the rock which includes it

renders mining easy and comparatively inexpensive. I have on my former visit noticed the stratum underlying with its *arsenopyrite* crystals. Large quantities of quartz were ready for the mill.

From this we went to

Jegoggin Point.

Between this and the mines no rock exposures were observed. At Jegoggin is found an interesting exposure. The rocks are chiefly micaceous schists. In these are quartz veins, large and small. One of the former is 10 feet thick. Interbedded are lenticular masses of hornblendic rock with crystals arranged in stellar form. Some of these schists are full of small garnets. This series of garnetiferous and hornblendic schists is evidently a section of the schists of Lake George and the line of railway. The strike of the strata is N. 50 E., S. 50 W. We did not take time to collect the sand among the rocks. It must be garnet sand.

I have thus, in a somewhat irregular manner, examined every important outcrop of rocks from Jebogue Point on the south to Meteghan Point on the north. I would now arrange the several outcrops in the form of a general section, thus:

1. Jebogue Point.
2. Sunday Point.
3. Town of Yarmouth.
4. Lighthouse Point.
5. West Point.
6. Jegoggin Point.
7. Cranberry Head.
8. Red Head.
9. Beaver River (County Line).
10. Salmon River to Cape Cove.
11. Meteghan.

Boundary Line of the two metamorphic series, auriferous and fossiliferous, in the Counties of Yarmouth, Digby and Annapolis,

I begin at Cape Cove, making the extensive *diorite* with quartzite the starting point. Passing on to the line of railway

we have a point in the line 2¼ miles north of the grey quartzite and argillite cutting. Following our *hypothetical line* to Bear River N. 40 E., we have the approximate boundary south of the village and Rice's mill. From Bear River to Moose River it lies between the granites and fossiliferous quartzites. It then follows the granite line from Moose River to Beale's Lake, and the Digby and Annapolis shore road, 6 miles from Annapolis. It follows the same line to Annapolis River, Paradise River and Lawrencetown. It passes south to the diorites which are on the south of the westward continuation of the Nictaux fossiliferous strata. Touching Nictaux it comes between the diorites, fossiliferous strata and the granites on the Lawrencetown and Albany road. At the back (S.) of Cleveland Mountain it lies between the granite and the overlying magnetite and fossiliferous strata. On the Albany road it lies between the gneissoid and the magnetite strata on the Nictaux and Albany road. It passes on to the division between the diorite and gneissoid rocks on the Bloomington Road. It then comes between the fossiliferous and quartzite and gneissoid rocks at Wheelock's, south of the New Canaan road, and then between the diorites and contorted gneissoid strata at Gordon's, south of the same road and east of the Annapolis and King's County line.

Correlation.

In Acadian Geology, Ed. 1855, pages 346-7, the following occurs regarding the age of the "Metamorphic district of the Atlantic Coast": "Hitherto each successive formation has been proved to be older than that which preceded it, by the evidence of direct contact, in such a way that the older could be seen to underlie the newer." Here we lose this chain of evidence. I have found no section in which the Devonian or Upper Silurian rocks, described in the last chapter, could be seen to rest on those now described. Yet I believe the group of rocks now under consideration to be the older of the two for the following reasons. On the St. Mary's River, fragments of slate and quartz rock from this formation are found in the lower carboniferous conglomerate, proving that these rocks were metamorphosed before

the commencement of the Carboniferous period. They must therefore belong at least to the Devonian group. They differ, however, so materially from rocks of that age that they cannot be assigned to it with any probability. We must therefore go back at least to the Silurian period for the time of their deposition; and possibly they may belong to that still older or Azoic series which has been recognized in Canada. Farther, that while there is evidence that much of the igneous rock of the Devonian hills was erupted during the carboniferous period, there is no evidence whatever that any igneous action occurred within the granite group as late as the commencement of that period, consequently the igneous as well as the stratified rocks of the present group are older than the last described (Devonian or Upper Silurian rocks).

In a paper which I read before the Geological Society, "On the Gold Fields of Nova Scotia," Journal 1862, I was led to infer the Lower Silurian age of the stratified rocks of the Gold Fields, from the consideration that they differed so much from Devonian, Upper and Middle Silurian rocks, that they could not be regarded as any of these, and as they could not be newer, therefore they were probably Lower Silurian metamorphic.

In the discussion that followed the reading of this paper, Sir William Logan maintained the opinion that the rocks in question were Devonian metamorphic. Sir R. I. Murchison at the same time, on the ground that gold had been discovered in quantity in our gold fields, considered that the opinion which I maintained was the correct one.

Subsequently Dr. Selwyn came to the conclusion that the said rocks are of Cambrian age, on certain considerations, particularly as he had discovered the Cambrian fossil *Eophyton* in the rocks of the Lunenburg Ovens. I had come to entertain the same view, i. e., to consider the formation of the rocks to be of Cambrian age, and to refer their metamorphism to Lower Silurian time, and to adopt the term Cambro-Silurian (Lower) as expressive of the age of the rocks metamorphosed, thus referring the age of the gold deposits to the Lower Silurian period. The term *Cambrian*, as here used, is, as understood by H. M. Geolo-

gical Survey of Great Britain, being applied to the formation next below the *Lower Silurian.* I make this explanation as the term Cambrian is now sometimes used differently.

The Devonian and Upper Silurian of Nictaux, according to "Acadian Geology," was transformed into Middle and Upper Silurian; and the Devonian granites were observed, at the back of Cleveland Mountain, at a point in the above described boundary line, *in contact* with Middle Silurian strata, without any metamorphism of the latter as the result of the contact. This indicates that the granite existed before the formation of the Middle Silurian strata. At some considerable distance south of the boundary line, at the Bloomington Road, granite is seen including fragments of the associated garnetiferous rocks, showing that the latter were formed and consolidated before the granite was *prepared* to enclose the gneissoid fragments. It was inferred that this condition was induced in the *pre Middle* and Lower Silurian, or *pre* Silurian period, (Cambrian) the gneissoid rocks being referred to *early Lower Silurian* or Cambrian time.—*Transactions* 1877-8.

At Moose River the new mines, considered by "Acadian Geology" to be of the same age as the iron deposits of Nictaux, produced the giant trilobite *Asaphus ditmarsiae* of a Lower and Middle Silurian race. The Bear River strata corresponding on the south side of the syncline have produced evidence of like age with the iron deposits. The underlying quartzites with fossils which intervene between the preceding and Greenland granites indicate a thickness too great to be included in any Middle Silurian series. I have run the boundary line between these and the granites.

The highly metamorphic quartzite specimen with a vein of quartz having the singular organism *Arthrostauros godfreyi* and a cast of *Moclurea,* described in *Trans.* 1878-80, indicates that three great bands of quartzite on the north side of the *magnetyte* strata may be fossiliferous. The specimen *might* be derived from any of the three, although I assigned it to Bogart's quartzite, which occupies a position relative to the *Asaphus* magnetyte, like that which Rice's mill quartzite and continuation

bears to Middle Silurian series on the south side of the syncline. These quartzites may all be regarded as of Lower Silurian age, probably Calciferous, as *Maclurea* seems to indicate. This would leave the Potsdam period for *metamorphism*, and the Cambrian and Archæan for *formation*. In this way I regard the Auriferous series as Archæo-Cambro-Silurian (Lower).

Article II.—Nova Scotian Fungi.—By J. Somers, M. D.

(Read Dec. 10, 1880.)

The following additions to the list of Fungi published in vol. V., part 2nd, Transactions of the Institute, 1879-80, have been collected during the past season; the greater number are from the vicinity of Halifax, the remainder are specimens principally Polyporei, kindly sent to me by A. H. McKay, Esq., of Pictou; of the latter there are several which I have not yet identified as growing here. Allowing for errors in diagnosis not inseparable from the study of a class of vegetables of which we lack a good American descriptive text book, we are compelled to depend almost solely upon Cook, no mean authority 'tis true, and comprehensive also. Yet one finds many species that depart from the characters of those described by Cook under their common genera. It will not therefore be surprising that we may find it necessary to make corrections in a future revision of the list.

Order Agaricini.

Sub-Gen. Amanita.

1. Agaricus (Amanita) spissus, *Fr.*, clammy Amanita, under Larch, Willow Park, Sept., 1880.

Sub-Gen. Tricholoma, *Fr.*

2. A. (Tricholoma) sejunctus, *Sow.*, N. W. A. woods, Aug. and Sept., 1880.

Sub-Gen. Clitocybe, *Fr.*

3. A, (Clitocybe) candicans, *Fr.*, Park woods, Nov. 1880.
4. A. (Clitocybe) opacus, *With* " "
5. A. (Clitocybe) fumosus, *P* " "

6. A. (Clitocybe) giganteus *F*, N. W. A. woods, Nov., 1880.

7. A. (Clitocybe) Sp., Willow Park woods, Oct. '80, approaches flaccidus, *Sow.* Not being satisfied with the diagnosis I append the following description: pileus 1 to 1½ inches convex at first, then plane with a small well marked umbo. at length depressed umbilicate or infundibuliform, the umbo. disappearing, colour of pileus, bright orange, shining mucus, the umbo. darker, redish, with lines passing therefrom to the margin, lines delicate formed by tearing or separation of the scales. When the pileus becomes depressed, the colour pales gradually, the red fading out, the orange becoming lemon, margin slightly wavy always involute, stem 3 to 3½ inch, somewhat flexuous stuffed, cortex fibrous, attenuated upwards rooting, colour lemon yellow, paling towards the apex and base, usually eccentric, spores white, gills decurrent, straight, narrow, white at first, becoming pale yellow, more especially towards their free borders, very abundant in swampy places, growing under larch spruce, upon decaying leaves.

8. Agaricus (Clitocybe) bellus, *Fr.*, Point Pleasant, under pines. Nov., 1880.

Sub-Gen. Pleurotus, *Fr.*

9. Agaricus (Pleurotus) salignus, *Fr.*, willow pleurotus, on trunks of living poplars. Oct., 1880.

Sub-Gen. Collybia, *Fr.*

10. Agaricus (Collybia) radicatus *Relh.* On dead wood, Willow Park, Oct., 1880.

Sub. Gen. Omphalia, *Fr.*

11. Agaricus (Omphalia) hepaticus, *Batsch.* Willow Park, Sept., 1880.

12. Agaricus (Omphalia) umbelliferous, *L.* Willow Park, Sept., 1880.

13. Agaricus (Omphalia) fibula, *Bull.* Willow Park, Sept., 1880.

Sub-Gen. Clitopilus, *Fr.*

14. Agaricus (Clitopilus) prunulus, *Scop.* Willow Park, Sept., 1880.

Sub-Gen. Claudopus, *Sm.*

15. Agaricus (Claudopus) depluens, *Batsch.* Near Melville, in a pasture, Sept., 1880.

Sub-Gen. Pholiota, *Fr.*

16. Agaricus (Pholiota) squarrosus, *Mull.* On stump, Halifax Common, Oct., 1880.

Sub-Gen. Naucoria, *Fr.*

17. Agaricus (Naucoria) semiorbicularis, *Bull.* Willow Park, Oct. 1880.
18. Agaricus (Naucoria) melinoides, *Fr.* Willow Park, Oct. 1880.

Sub-Gen. Psalliota, *Fr.*

19. Agaricus (Psalliota) arvensis, *Schaff.* Camp Hill, Sept., 1880.

Sub-Gen. Psilocybe, *Fr.*

20. Agaricus (Psilocybe) fœnisecii, *P.* Willow Park, Sept., 1880.

Sub-Gen. Panæolus, *Fr.*

21. Agaricus (Panæolus) separatus, *L.* Om. loc. Sept., 1880.

Sub-Gen. Psathyrella, *Fr.*

22. Agaricus (Psathyrella) gracilis, *Fr.* Willow Park, Oct., 1880.
23. Agaricus (Psathyrella) disseminatus. Among sphagnum, Willow Park, Oct. 1880.

Gen. 2, Coprinus. *Fr.*

24. Coprinus comatus, *Fr.* Public Gardens, Hx., Sept., 1880.
25. Coprinus ovatus, *Fr.* " " "
26. Coprinus plicatilis, *Fr.* In pastures. July, Aug. 1880.

Gen. 3, Bolbitius, *Fr.*

27. Bolbitius fragilis, *Fr.* On cow droppings, Willow Park, Sept. 1880.

Gen. 4, Cortinarius, *Fr.*

Sub-Gen. Phlegmacium, *Fr.*

28. Cortinarius (Phlegmacium) turbinatus, *F.* Pictou, Sept., 1880.

Sub-Gen. Myxacium, *Fr.*

29 Cortinarius (Myxacium) collinitus, *Fr.* Willow Park, Sept. 1880.

Sub-Gen. Inoloma, *Fr.*

30. Cortinarius (Inoloma) callisteus, *Fr.* Willow Park, Sept., 1880.

31. Cortinarius (Inoloma) sublanata. Willow Park, Sept., 1880, and Pictou.

Sub-Gen. Hygrocybe, *Fr.*

32. Cortinarius (Hygrocybe) armeniacus, *Fr.* Omne loc. Sept., 1880.

33. Cortinarius (Hygrocybe) castaneus, *Fr.* Willow Park, Sept., 1880.

Gen. 5, Lepista, *Sm.*

34. Lepista nuda, *Bull.* Willow Park, Sept., 1880.

Gen. 10, Russula, *Fr.*

35. Russula adusta, *Fr.*, "scorched russula." In Pine Woods, Sept., 1880.

36. Russula sanguinea, *Fr.*, Blood-red russula. In Pine Woods, (common), Sept., Oct., 1880.

Gen. 13, Masrasmius, *Fr.*

37. Masrasmius alliaceous, *Fr.* N. W. Arm woods, Sept., 1880.

38. Masrasmius terjinus, *Fr*: Willow Park and Pictou, Sept., 1880.

Gen. 15, Panus, *Fr.*

39. Panus stypticus, *Fr.* Pictou, Oct., 1880.

Gen. 17, Schizophyllum, *Fr.*

40. Schizophyllum commune, *Fr.* On a spruce stump, Willow Park, Oct., 1880.

Gen. 18, Lenzites, *Fr.*

41. Lenzites betulina, *Fr.* On old trees, willow, poplar and birch. Sept., 1880. North West Arm woods.

42. Lenzites sepiaria, *Fr.* On pine stumps. Sept., 1880.

43. Lenzites flaccida, *Fr.* On stumps and dead trees. Sept., 1880.

Order II.—Polyporei.

Gen. 19, Boletus, *Fr.*

44. Boletus luteus, *L.* Under spruce. Willow Park, Sept., 1880.
45. Boletus flavus, *With.* Common. Sept., Oct.
46. Boletus badius, *Fr.* Under pine and hemlock. Willow Park woods, Sept., 1880.
47. Boletus ampliporus, *Beck.* Pictou. Oct., 1880.
48. Boletus palustris, *Beck.* Pictou and Willow Park, Oct., 1880.

Gen. 21, Polyporus, *Fr.*

49. Polyporus leptocephalus, *Fr.* On dead wood, Willow Park, Sept., 1880.
50. Polyporus saligenus, *Fr.* On Willows, Halifax Common, Oct., 1880.
51. Polyporus spumeus, *Fr.* On poplars. Oct., Nov., 1880.
52. Polyporus vulgaris, *Fr.* On rotten wood, Willow Park, Oct., 1880.
53. Polyporus incarnatus, *Fr.* Willow Park, Oct., 1880, and Pictou.
54. Polyporus radiatus, *Fr.* Near Melville Island, Hx., and Pictou, Oct., 1880.
55. Polyporus hirsutus, *Fr.* Common. Melville Island and Pictou, Oct., 1880.
56. Polyporus abietinus, *Fr.* On spruce and hemlock. Oct., 1880.
57. Polyporus perennis, *Fr.* Pictou, Oct.
58. Polyporus cinnabarinus. Pictou, Oct.

Gen. 23, Dædalia, *Fr.*

59. Dædalia confragosa, *P.* On dead willows. Oct., 1880.
60. Dædalia unicolor, *Fr.* On stumps. Oct., 1880.

Gen. 24, Merulius.

61. Merulius lachrymans, *Fr.* On rotten plank in a cellar. Aug.

Gen. 26, Prothelium, *Fr.*

62. Prothelium friesii, *Mont.* Pictou, Oct., 1880.

ORDER III.—Hydnei, *Lin.*

Gen, 28, Hydnum, *Linn.*

63. Hydnum zonatum, *Batsch.* Pictou, Oct., 1880.

Gen. 34, Odontia, *Fr.*

64. Odontia fimbriata, *Fr.* On dead wood, Willow Park, Oct., 1880.

ORDER IV.—Auricularini.

Gen. 36, Craterellus.

65. Craterellus, *sp?* Willow Park, Oct., 1880, on the ground.

Gen. 38, Stereum, *Fr.*

67. Stereum purpureum, *Fr.* On dead branches, Willow Park, Oct., 1880.

68. Stereum hirsutum, *Fr.* Common on stumps, &c. Oct., 1880.

Gen. 39, Hymenochæte, *Sev.*

69. Hymenochæte rubiginosa, *Sev.* Omne loc. Oct., 1880.

Gen. 42, Cyphella, *Fr.*

70. Cyphella fulva, *B. & Rav.* On dead sticks. Sept.. 1880. W. P.

ORDER V.—Clavariei.

Gen. 46, Clavaria, *L.*

71. Clavaria coralloides, *L.* On the ground. Common. Sept., 1880.

72. Clavaria rugosa, *Bull.* Pine Woods, Oct., 1880.

73. Clavaria inequalis. Pine Woods, Oct., 1880.

ORDER VI.—Tremellini.

Gen. 49, Tremella, *Fr.*

74. Tremella mesenterica, *Retz.* On dead wood. Oct., 1880.

FAM II.—Gasteromycetes.

ORDER IX.—Trichogastres.

Gen. 69, Bovista, *Dill.*

75. Bovista plumbea, *P.* North Common, Hx., Oct., 1880.

Gen. 70, Lycoperdon, *Tourn.*

76. Lycoperdon gigantum, *Batsch.* Giant puff-ball from Mr. R. Morrow's grounds, Sept., 1880.

77. Lycoperdon, pusillum, *Fr.*. Little puff-ball, at the roots of willows, North Common, Hx., Oct., 1880.

78. Lycoperdon saccatum, *Vahl.* Elongated puff-ball. N. W. Arm, Oct., 1880.

79. Lycoperdon pyriforme, *Schœff.* Pear-shaped puff-ball. On stumps in various places. Oct., 1880.

Gen. 71, Scleroderma, *F.*

80. Scleroderma vulgare, *Fr.* On roadsides. Common. Aug.

ORDER X.—Myxogastres.

Gen. 74, Lycogala, *Mich.*

81. Lycogala epidendrum, *Fr.* On rotten willow stumps. Oct., 1880.

ART. III.—ON THE OCCURRENCE OF LIEVRITE IN NOVA SCOTIA. BY EDWIN GILPIN, A. M., F. G. S., *Inspector of Mines.*

(Read January 17, 1881.)

I WISH to bring to the notice of the Institute the occurrence in Nova Scotia of a mineral resembling Lievrite, as described by Sir William Logan in his Geology of Canada, p. 465.

The mineral as found in this Province came from Gabarus, in the Island of Cape Breton, and was given to me some years ago by a man who thought it was an ore of Molybdenum.

On examination I found the colour to be black, with a faint olive tinge; fracture uneven, glistening, and subvitreous; hardness, 6; specific gravity, 3.75; streak greyish. The specimen was faintly magnetic, but this property may have been more strongly manifested when it was fresh. It fused before the blow-pipe to a dark magnetic slag, and gave the ordinary iron reactions. It gelatinised slightly with Hydrochloric acid.

My analysis of the specimen is as follows, and for the sake of comparison, is placed beside that given by Sir W. Logan, as cited above:

	Nova Scotia.	Ottawa.
Iron protoxide	54.545	56.52
Iron peroxide	6.620	10.80
Silicic acid	28.570	27.80
Manganese peroxide	2.507	trace
Sulphuric acid	trace	—
Lime	3.030	.64
Magnesia	1.100	2.59
Moisture	3.115	1.20
Carbonic acid	trace	—
	99.487	99.55

The specimen brought me was stated to have come from a bed a few inches thick on the south shore of Gabarus Bay. I do not know the exact locality; consequently, some doubt may arise as to its proper geological age. Mr. Fletcher, of the Canadian Geological Survey, states in his Report of Progress, 1875-76, that this part of Gabarus Bay is occupied by felsites of Laurentian age, which is confirmatory of the age assigned to the mineral by Sir W. Logan.

The description in the Geology of Canada is as follows:

"It contains some black mica, and portions of red garnet, and forms a mineral of a velvet black colour, weathering rusty red, but having within a shining submetallic lustre. Its hardness is 5.5, and specific gravity 4.15. Powder, yellowish ash-gray. Slightly translucent on the edge, and strongly magnetic. Brittle with an uneven fracture, and cleavage imperfect in two directions oblique to one another. Before the blowpipe it intumesces and yields a black slag; with hydrochloric acid it gelatinises. From its composition (given above) not less than its physical characters, this substance is regarded as a variety of Lievrite. It probably forms a bed in the Laurentian series, as a boulder of it, nearly a foot thick, was found near Ottawa, but the rock has not been observed in situ."

The analyses of this mineral from Elba, as given by Dana, all show the presence of 11 to 15 per cent. of Lime, which is present in small quantities only in that from Canada. And he

regards the specimen described in the Geology of Canada as representing rather a variety of Fayalite. The occurrence of a mineral, however, in Nova Scotia, resembling it so strongly, would show that it may be most properly considered a variety of lieorite.

The mineral is principally found in Elba, at Rio la Marina and Cape Calmite, where it occurs in disseminated and grouped crystals. At one time the crystals were abundant, the finer specimens are now rare, and bring extravagant prices. On this Island it occurs in dolomite with pyroxene, etc. It has been found in Siberia, Silicia, and Norway.

In America it was formerly obtained in Cumberland, Rhode Island, and Somerville, Mass., in long slender slightly rhomoboidal prisms, longitudinally striated and sometimes presenting terminal faces. These prisms are implanted on granular quartz with minute crystals of magnetite, but the supply now appears to be exhausted.

The mineral I have shown you this evening is not considered to exist in quantities which would lead to any hope of its finding an economic value. Its decomposition, however, would supply percxides of iron, and compounds such as these may have formed a most important source for many valuable iron ore deposits occurring in strata succeeding the Laurentian.

Art. IV.—On the Birds of Prey of Nova Scotia.—By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read 10th Jan.*, 1881.)

In making this list I have personally identified, with one or two exceptions, every species in it. I will not say that no other specimen may be added, but that if hereafter noted, it will be a very rare one to have escaped my notice of more than thirty years. Personal identification of each species also by the writer, even if in a narrow limit, adds always to the interest and value of a paper. In classification I have used Key to N. American Birds, by Dr. Coues, 1872, of the value of which it scarcely needs

any mention from me. I have found, with one or two exceptions, all the birds of this order common to North Eastern America, in Nova Scotia, and noticed those I expected to find and failed. From their nature and food they are rare everywhere, and one who has witnessed the scarcity of all animal life in our forest, and the little bird life even in our cultivated fields, is not surprised by finding a greater scarcity of this order. The innumerable flights during the autumn of what are called shore birds, chiefly composed of the genera Tringa Totanus and closely allied species in their autumn migrations, attracts numbers of the genus Falco. Our marshes, especially after mowing, which lays bare the runs of field mice, and the haunts of frogs, snakes and other reptiles, attracts the harriers and buzzards, and the sea shores of the Bay of Fundy, at ebb tide, left in far-reaching and muddy flats abounding in stranded fish, bring the eagles and fish hawks for their prey, the latter seizing its living prey from the shallow pools, whilst the former, when not plundering the fish-hawk, contents himself with the dead and stranded fish. Except the grouse, the hare, and perhaps shrews in the depth of the winter forest, or a white weasel or jay bird, or a red squirrel now and then, the stern winter has locked in snow and ice everything that makes food for the few owls that hybernate with us. The few eagles and fish-hawks I have dissected I have found fat, even in winter; the hawks generally thin. I have never identified any kites in Nova Scotia, but my son has observed fork-tail hawks in the air, which I have also seen, but very rarely, most probably the genus Nauclerus.

List of Rapacious Birds of Nova Scotia.

FAMILY STRIGIDÆ—(Owls).

Bubo, virginianus—Great horned owl.
Otus, vulgaris (var. Wilsonianus)—Long-eared owl.
Brachyotis, palustris—Short eared owl.
Syrnium, laponicum (var. Cinerium)—Great grey owl.
Syrnium, nebulosum—Barred owl.
Nyctea, nivea—Snowy owl.

Surnia, ulula (var. Hudsonia)—Hawk owl.
Nyctale, tengmalmis (var. Richardsoni)—Tengmalmi's owl.
Nyctale, acadica—Saw wet owl.

FAMILY FALCONIDÆ.

Circus, cyaneus (var. Hudsonius)—Marsh hawk.
Accipter, fuscus—Sharp shin.
Accipter, cooperii—Cooper's hawk.
Astur, atriccapillus—Goshawk.
Falco, sacer—Jerfalcon.
Falco, communis—Duck hawk.
Falco, columbarius—Pigeon hawk.
Falco, spaverius—Sparrow hawk.
Bateo, borealis—Red tail hawk.
Bateo, lineatus—Red shoulder hawk.
Archibuteo, lagobus (var. Sancti Johannis)—Rough legged buzzard.
Pandion, haliætus—Fish hawk.
Aquilla, chrysaetus—Golden eagle.
Haliaetus, leucocœphalus—Bald eagle.

You will find in this list, taken as regards its nomenclature from Coues' Key, that many generic as well as specific names are changed from Wilson, Audubon, Nuttall, Richardson, and, even Baird, or other recent writers. The greatest change is with the specific. Whilst we accept the changes from the older authors as the necessary progress in the science, yet we can see in the differences from the modern ones that one principle rules them, a nearer return to truth, to the principle of returning to the specific given by the first discoverer of the species, allowing him the exclusive right of naming, and finally in birds almost identical in both continents the allowance of geographical variation from one common origin. This of course is the most philosophical way of settling points beyond our reach. Field naturalists can scarcely be allowed the privilege of criticising, which must be the result of intimate knowledge of large collections and libraries, and, as respects the author of the Key, still larger experience of field life. Yet one may be allowed to say

that anything that reclaims the science from the divisions of sub-families and sub-genera, and innumerable lists of synonyms made, not for truth but for personal exaltation, must be hailed with pleasure by all true naturalists. Of the family of owls which inhabit our Province, the Halifax museum, with the exception of the great grey owl (s. laponicum), contains an excellent collection of every species I have identified myself. The great grey owl was taken some years ago in Pictou County, and a specimen was in the collection of the late Dr. McCulloch, of Pictou town. This is the only recorded instance I know of its being here. The great horned owl (B. virginianus) is common. It both breeds and winters, usually keeping in the thick forests, seldom coming out in the clear country. I have seen its young in the spring, and the adult at all seasons of the year. A specimen shot at Digby, Feb. 1876, when feeding upon a black duck, was nearly white, washed by pale ferruginous, and barred and spotted light brown. The pure white chin remained unchanged, as it has done in every individual I have examined, how much otherwise the plumage may have been altered. Though not resembling Richardson's figure, I thought it may have been the Arctic variety. Our camp fires attracted them when camping on the shores of a forest lake in Digby county, Sept., 1871. By answering their wild feline cries, we kept them about us the long night, unseen, yet continually shifting from one spruce fir to another, amongst which our camp was pitched. Their prey is nocturnal, and thus less likely to be known. Grouse, hare, and even ducks may be readily captured by this powerful bird, which uses its beak as well as its claws in destroying life. A poor pet crow, the favorite of the village at Annapolis, visiting every house for its bone, and sleeping now in an old porch, now in an unfinished church, or under the eave of inhabited houses, alarmed the inmates, beneath whose eaves it had sought a roosting place, by its shrill cries one calm midnight. On going to its rescue a large nocturnal bird of prey floated away. At sunrise it was found dead on the grass beneath, no doubt a victim of this powerful nocturnal prowler. Of the short eared owl (B. palustris) and the long eared owl

(O. vulgaris), they may be said, though not rare, still not very common, I have Mr. Downs' authority that the short eared nests in Nova Scotia, near Halifax. Probably both do, yet the number of both that appear during winter proves migration to be the chief cause of their presence with us. Of the barred owl (S. nebulosum), my notes give May as the month I identified him in the breeding season. I have no doubt he winters with us, but my notes have no monthly dates. The hooting of this owl comes down on the night wind to you like the loud broken laughter of many men. A stranger would easily suppose he was near a large logging party. The majestic snow owl (N. nivea) I do not think nests with us. He is usually a winter visiter, though I saw him once, August, 1854, on Sable Island, with all his feathery alpine plumage, sitting upon the hot sand, the snowy, thick muffled claws reposing on sand that heated your touch. A few years after the Island had been stocked by domestic rabbits, this bird made his appearance, in 1827, and ever after paid it an annual visit. I saw him patiently watching the burrow mouth, instantaneously to seize its emerging owner He is usually our winter visiter, and like other species sometimes comes in flocks. In the winter of 1876 Mr. Egan, at Halifax, had fourteen specimens at one time. The settlers told me they sat like pigeons upon their barns, coming out of the forest at dusk. There had been no storms or local reasons for this migration which extended into New England. The hawk owl (S. ulula), is also a winter visiter. He shows himself sometimes in flocks. Some years ago there were more than a dozen brought into Halifax, then not seen for years, and of late returning singly. Of Tengmalmi's owl (N. tegmalmi) I have seen but few specimens, and believe it very rare. Four are the utmost I have seen in Nova Scotia. The saw wet (N. acadicæ) is common and resident, keeping the deepest forests as his abode, frightening the Indian at his bivouack, who never will answer him or allow any one to in his camp, for fear of impending misfortune. Yet he, too, appears sometimes in flocks in the open. During the spring of 1879, Mr. Egan had numerous specimens offered him. The little red owl (S. asio), so common in New England

and also in Newfoundland (Reek's Zoologist, 1869,) I have never seen here, in which Mr. Downs joins me. In its migrations it passes perhaps north of us. In ending my remark on our owls, I may say that about four I have identified as nesting with us, the others winter visitants, and that with the exception of the great grey owl, there are excellent specimens of each species in the Halifax museum.

In passing to the diurnal birds of prey, the Falconidæ, we find more power and strength developed in each individual, though denuded of its soft coating, the hind toe (in the owls very small comparatively) greatly increased, a greater propensity to use the claw than bill, and a greater ardor of temperament, and power of wing action. This family naturally separates itself into the harriers, the falcons, the hawks, the buzzards, and the eagles. I mean as regards Nova Scotia, since the kites and vultures never come to us. Of the harriers, resembling the owls in a facial circle, we have one species (C. cyaneus), a geographical variety of the old world harriers. He is common, and most probably breeds with us, as he is seen during that season, but I have no note of his nesting. He leaves us during November, the swamps then being frozen, and the mice, reptiles and snakes, his usual food, hybernating. He is seen beating our new mown fields and swamps, but never hunting the shores abounding with shore birds. The females and young are much more abundant than the slate grey male. In his habits he resembles the buzzard, as he does somewhat in bill and claws. In the next family of hawks we have the sharp shin (A. fuscus), Cooper's hawk (A. cooperii), and the goss hawk (A. atricapillus); this family including two genera, Astur and Atricapillus. The sharp shin is, perhaps, our most common hawk. I have noted him in May and in December. Little doubt he breeds with us, though I do not know his nest. Though slenderer than the falcons, his bill lighter, and upper mandible scarcely notched, he is by no means their inferior in audacity and headlong pounce. One broke the glass of Mr. Downs' aviary in attacking a canary, seen through. He will often attack caged birds hanging in country houses, and even enter the city for the same game. Cooper's hawk (A.

cooperii), an enlarged model of the last, is very rare. I am indebted to Mr. Egan for notes of one specimen mounted by himself and afterwards sent home to England. I have never seen it myself. The goshawk (A. atricapillus) is common, and seen during the breeding season, though I have no notes of time. A pair wintered near the light-house at Digby Gut, 1880 ; but this is unusual. The vicinity to the sea would make one suppose they lived upon fish. Few hawks of any species, save eagles, are seen after December, even the fish hawks leave us. One would suppose a duck upon the water would be an easy prey for them, and our winter shores are covered by them ; but I have never heard or have read of any hawk making like the fish hawk what may be called a water pounce. The goshawk is the type of the great hen hawk of the farmers' wives. He comes out in the open, is not seen beating marshes like the buzzards and harriers, or the sea sands like the smaller falcons, but prowls about the homesteads, coming suddenly with the swiftness of the gale from nowhere, and sweeping a hen or chicken from the very feet of its owner, gone as suddenly as it came, and losing in the deadly rush for a time that caution and wariness which ever keeps him from the vicinity of man. The next family are the Falcons; a more powerful organisation comparatively; a keener ardor and untamed spirit; the habit of taking their prey with a pounce from a tall tree, or perpendicularly from the air, rather than hunting along the surface; a stronger, shorter, and peculiarly notched bill, and pointed wing, define this family as it were abruptly from the others. It is the type of the highest excellence of the whole order. Of six species inhabiting North America, four are found in Nova Scotia; two probably nesting, the others rare, and as respects the jerfalcon accidental visiters. In F. sacer we miss the old name so long given by naturalists to the falcon of antiquity, but bow to the law that gives to the first scientific discoverer (Foster) the right of the specific name. Of this historical bird, the companion and pet of mediæval princes, the subject of the ancient pseuo science of hawking, with all its complex phraseology, I am indebted to Mr. Downs for my sole note. One specimen wds mounted by him

some twenty years since, being taken by a vessel on the coast and brought to Halifax, and a second specimen is exhibited this evening by himself. They are not uncommon at Newfoundland, being called white hawks, and sometimes stray south of us, into New England, doubtless taking the inland route. The duck hawk (F. communis), and here again we lose the fine old name peregrinus, a bold and beautiful bird, with the eye, toothed bill, and powerful claw of its race in the highest beauty and perfection in my experience, is very rare. There was a good specimen in the Halifax Museum 1870, and Mr. Downs has noted it. This falcon is the anatum and great footed hawk of American writers. The pigeon hawk (F. columbarius) is perhaps the most common hawk of our Province. My notes are September and November, but still I believe he nests with us or is found during the time of incubation. He is a true falcon, in dash, temerity and force. He will strike a duck upon the wing and lacerate and tear up the whole back and neck region so as to produce death. He occurs here with a variation of colour. In the Provincial Museum are specimens with four obscure whitish bars upon tail. A specimen in Mr. J. M. Jones' collection agrees with this; the bars broader. Another, shot by Mr. Alfred Gilpin, has five white bars, the fifth obscured by tail coverts. Another specimen, shot by John Baxter, Nov. 4, 1880, has five dark bars crossing the tail, the fifth hid by tail coverts. In this specimen the colour was more plumbeous on back and rump and tail, and more whitish below. I have not specimens enough to show any analogy between the plumbeous coloured back and darker tail bars, and whiter colour below. Coues asserts the female has white bars. Reeks (Zoologist, 1869,) describes it at Newfoundland, as having dark bars. The question is also complicated by Richardson's merlin or Aesalon of the old world, very allied to this species, being found in America, though denied by Coues. We find this very active and bold falcon on the flats of the sea shores, pouncing ærially upon the tringa totani and other shore birds in their autumn migration. He lingers into November before he leaves us. There is no prettier sight than on a warm September day, in the Digby Basin, when the great Bay of

Fundy tide has filled up to the very rushes the salt water estuaries and creeks; when the peeps and shore birds are like snowy drifts on the edge of the tide, waiting for the ebb; when the herons, coming full twenty miles from their heronry by the forest lake side, are roosting in awkward groups on the spruce pines and birches overhanging the tideway, also waiting for the ebb; then an instant alarm of shrieks from the herons, followed by an instant barking of the crows, rising and falling about the tops of the pines, disturb you, as floating in your canoe you are watching how a feathery gull, or an early scoter, is breaking the majestic mirror all around you. Malti Pictou, your Indian, says, "May bee herons don't like the hawk"; and then, as you turn your eyes landward, you see the hawk sailing in short circles around and then with a sweep fetching down upon the herons, recovering himself and passing with lazily flap of wing slowly their roosting trees. He, too, is waiting for the ebb. The sparrow hawk (F. sparverius) is not rare with us; my notes of him are in Sept., but Mr. J. M. Jones allows me to say, he has seen them during the summer in the valley of Annapolis, with all the habits of a resident bird, and probably nesting. Its beautiful colouring and bold upright form and audacity makes him everywhere a marked species. Of the next family of buzzards, I have identified three species. This family, more robust than the last and more powerful in form, have less audacity, sitting for hours listlessly on a dead tree, living on the smaller mammals and reptiles, which flying low they snatch rather than pounce upon, are still audacious plunderers of the farm yard. Of the red shouldered hawk (B. lineatus) I have only Mr. Downs' notes. I have never seen it. The winter falcon (A lagobus) is seen rarely here. A specimen in the Halifax Museum agrees with Richardson's figure and description, the colours scarcely so bright. I saw one specimen of a black hawk in Mr. Roue's collection, at Halifax, 1870. It was alive and therefore could not be examined closely, but it looked so very unlike in size and figure the lagobus that I could scarcely call it a nigritism of that bird. But still I have nothing explicit enough to call it a true species, especially as the best writers unite in

not considering it such. I can not but think there is a lost hawk in this family. The red tail hawk (B. borealis) is a common hawk with us. My notes give him the middle of April, Summer and November, resident but leaving us in winter. Our specimens, in the finest nuptual plumage, differ from Richardson's description both in the colour of tail and breast. They have very much more brown and ferruginous on breast, and the tails of the brightest chestnut red, the two outer tail feathers obscurely barred. Richardson says of his specimen, killed Carleton house, May, 1827, "The tail is brownish orange, tipped with soiled white, with a subterminal band of blackish brown, there are also traces of thirteen other brownish bars." These markings do not accord with the bright chestnut red with no bars, of ours, excepting the broad subterminal one. At the same time, Mr. Downs kept in confinement for several years a pair of red tails which always kept the brownish bars on brownish red tails, resembling Richardson's. Thus we have this buzzard in two forms. The warm southern form of Wilson and the paler arctic one of Richardson. The specimens in the Halifax Museum and private collections are all young birds, but agree exactly to Richardson's description in bill, length of primaries and legs and feet. I kept one of the southern forms in confinement for several years. The second year he lost the brown tail of the immature bird and developed a bright chestnut one. I fed him upon livers and raw meat, which he received on his bill, but immediately transferred to his feet, tearing it, from which he fed. On giving him a dead bird he instantly became excited, spreading out his wings and tail and bending over it, with erect crest and head plumage, as it was fixed to his perch by his claws. He usually tore the sides open, thrusting in his hooked bill and drawing out the intestines. His blood stained bill and feathers, with his continuous, guttural, angry cries, and piercing eye underneath its bony brow, showed for the time he was no poor captive tied with a string. The fish hawk (P. haliætus) stands out from the family so broadly that he almost deserves a family alone. Eagles are admitted carrion eaters, and there are ugly stories told about the noblest falcon, of preying on vermin and

dead animals. He, of all, kills his living prey. Should he drop a fish from his claws, his instincts are never to pick it up. His limbs are muscular to the extreme, scarcely covered by the shortest feathers, and his legs and claws immense for his size; the joints are so loose in their articulation as to have a side motion, and the toes so adjusted that they may work in pairs, like the parrots, two before and two behind; the proper hind toe small, in this particular approaching the owl. The very peculiar scales they are covered with, and the roughness of the sole, still further recedes it from the typical foot of the falconidæ. They breed in our forest some miles from the sea, but do not winter with us. He may be seen regularly hunting our estuaries and forest lakes. Now gracefully soaring, and now falling prone as a stone into the water, and then emerging with a fish in his claws, heavily laden and seeking the forest. I never could observe if he went beneath the water, as everything was covered by the splash of water caused by his fall. It is asserted that he does, by men of science and by the practical observer. It must be a very powerful bird to rise loaded from beneath the wave. The rising sun caught me amongst the hills of St. Clements, one morning after a long night ride. The air was filled by dismal screeches, and I nearly broke my back twisting in my saddle till I saw right over my head a fish hawk heavily laden with a fish in his claws and a bald headed eagle continually soaring above and pouncing down upon his back. In a moment the fish came diagonally falling, the level beams of the early sun glinting it with silver. The eagle dropt like a stone beneath it, catching it on its upturned claws, and flapped away, whilst the poor plundered hawk was heard screaming long after out of sight. The eagles are the last upon our list. The golden eagle (A. crysaetus), the eagle of the ancients, the bird of Jove, remains the whole year, and nests with us. They are more rare than the bald heads, a pair dominating over a very wide country. I have seen four, three of them alive, taken in traps, the fourth killed by a woman in Pictou County. One in captivity was a very bold bird, attacking everybody that approached him with his claws. This attack was so fierce that a calfskin boot would have soon

been torn from your foot. The bold grandeur of its massive head, supported by a neck arched like a horse and adorned by shining and golden hackles, imposed itself upon you as the type of force and pride; and yet he was trapped. He was seeking dead meat, which he devours as well as carrion. In beauty and severity of expression he far surpasses the bald head (F. leucocephalus), the only other eagle we have. Though he will eat carrion, and gorge himself over the carcase of a dead horse: though he will enter your gardens, and strike a pea fowl or Brahma pullet: yet he adds dead and stranded fish to his larder. Hence his abundance, and his fatness. He remains all year with us, especially about the shores of the Bay of Fundy, building his nest sometimes in trees, at other times on scraggy rocks. As usual, the perfect adults with milk-white tail and head are few in comparison with the brown and splotched white young, and what is singular those young are larger in their dimensions than the adults. I have known them six inches longer than old male adults. An immature bird shot near Halifax, in January, 1855, measured nearly eighteen feet wing spread, with tail of sixteen inches. He was shot rising from the carcase of a dead horse upon which he had gorged himself. These dimensions exceed the dimensions of the Washington eagle. In studying many specimens, both adults and young, as regards scutillation of tarsus, I found them to vary so much, not only among individuals but in the individual itself, in number, as to be of no use as a typical mark. Audubon makes it a differential mark in the Washington eagle. An eagle about two weeks old, now in Halifax Museum, has twelve on tarsus and twenty on middle toe. The legs of an adult, shot at Digby, 1880, and mounted as candlesticks, has none upon tarsus. One must conclude that they are shed and renewed. In all my examinations of grey or splotched white and brown specimens, I have never seen any but what were the young of the bald. In the list of rapacious birds I have presented to the Institute as inhabiting Nova Scotia, identified by myself or friends, we find that with the exception of the screech owl (S. asio), we have all the New England species of owls as visitants or residents, and this as a

rather remarkable exception, as being abundant in New England and Newfoundland, and migratory. Owls are a peculiarly forest family, and our still remaining pine spruce forests, our barrens and lake country, give them shelter and food. The great horned (B. virginianus) owl, the barred owl (S. nebulosum), the long and short eared owl (O. vulgaris and B. palustris), and the saw wet (N. acadica) are resident, breeding with us, their nests and young having been taken, or they themselves having been seen during all periods of the year. The more arctic species are our winter visitants, breeding and nesting to the far north. The great grey owl (S. laponicum) is a very rare visitant. The snow owl and the hawk oil (Nyctea nivea, and S. ulula) appear during some winters, almost in flocks, a thing unusual for birds of prey, and showing great scarcity of food. The saw wet (N. acadica) is seen approaching the clearings during winter, also in flocks, whilst Tengmalmi's owl (N. tengmalmi) is very rare. One sees them scarcely ever during the day time in our solitary forests either winter or summer. During the night we hear them in our summer or fall camp. The fierce feline cry of the great horned, or the broader sounding hoots of the barred, as well as the stridulous squeaks of the saw wet. Unless the hunter hides his grouse or hares he may have shot, cunningly beneath the snow, when he returns to them he will find that an unseen but watchful prowler has stripped of feathers or fur, torn and devoured them. This feeling of being watched by the unseen is one of the charms of our alpine forests. If you take your back track in early morning after coming to camp late in the evening, you will find you have been stealthily followed for many a mile by the tracks of the lynx or wild cat. During the night the foxes and the bears, nay even the moose, is warily reconnoitering the intruders, and the owls coming to the camp fire, all prowlers in the dark for what they may pick up. Of the diurnal rapacidæ, we find our Province has the usual New England species, yet there are a few noteworthy exceptions. I have never seen the broad winged or Pennsylvania buzzard here (B. pennsylvanicus), nor the common English buzzard of Richardson (B. vulgaris), or the short winged buzzard (B. butoides). The kites also

I have never seen. If they migrate north of us, as it seems they do, they go inland and not along the sea coast. Neither are they winter visitants. A stray red tail hawk (B. borealis) is seen during winter. But the gosshawk (A. atricapillus) may be called a persistent winter visiter. Specimens of him are brought to Halifax frequently at that time. He and his mate, all winter long, perched on the scrubby pines overlooking the Bay of Fundy from the North mountain, and the moose hunters see him feeding on the white snow upon the grouse he has struck in the thick forest. Though this family do naturally resolve themselves into harriers, buzzards, hawks, and falcons, some pursuing live game, others pouncing upon it, others picking it from the ground, and taking lizards, frogs, and even insects, yet with the exception of the timid fish hawk, the only one who takes his live meat, they all will descend to dead meat and carrion. The imperial eagles being the nearest in this to the vultures who never take their game alive. I have never heard of the bald heads taking their fish alive, whilst the fish hawk, if he drops his fish, will never seek to reclaim it, seemingly having no instinct to catch fish except from the water. To him alone is due, if it is an honour, never to sit, except to the Abbyssinian banquet of quivering meat.

There are many traditions and stories of children being carried away by eagles; they are usually the traditions of former times, and of spectators and eye-witnesses long since relieved of the burden of flesh. But there is one instance which happened in Labrador, where the parties are still living. An English missionary was visiting a fisherman's family in their hut by the shore; the father of the family came stumbling in for his gun, all but unutterable; he handed it to the missionary, saying, "I can't kill my own child, do your best." Gun in hand the clergyman stood upon the shore, and saw an eagle about eight feet in the air slowly rising weighted by the living, child held by its clothing; he covered his bird, fired, and it dropt so gently to the ground that the child was unhurt, though the slugs by which the gun was loaded had done their work. This gentleman, the Rev. Mr. Wainwright, now holds a good position in the diocese of Honolulu, in the Pacific.

Article V.—A Contribution towards the study of Nova Scotian Mosses.—By John Somers, M. D., F. R. M. S.

(Read February 14, 1881.)

The following additions to the Moss Flora of the Province, see "Vol. IV, V, Transactions, 1877, '78, '79 and '80," have been collected during the past season:

Sect.—Pleurocarpi.

Ord.—Fontinalei.

Genus—I. Fontinalis.

Fontinalis, antipyretica, *L.*

Sporangium, immersed, stems triquetrous, leaves sharply keeled, the margin reflected on one side; on stones in running brooks, near Truro, Sept. 1880: essentially the same as the European species.

Order—Hypnei.

Genus—Hypnum.

Hypnum, demissum, *Wils.*

Stem prostrate, branched, more or less divided; leaves secund, narrow, lanceolate, sporangium small, cernuous; lid with a long, slender beak. On quartzite rocks, Truro, Sept. '80.

Hypnum, denticulatum, *L.*

Leaves complanate, ovate, apiculate; margin recurved, two-nerved, toothed sporangium; oblong curved, cernuous; lid conical, acute. On banks of brooks in damp, shady places. Aug. '80.

Order—Isothecii.

Genus—Climacium.

Climacium, dendroides, *Web. & Mhor.*

Dendroid, rhizome, creeping stem, naked below; erect, dividing above like a miniature tree; leaves ovate, lanceolate, toothed above; nerve reaching the tip; fruitstalks strong, red; aggregated sporangium; large, erect, lid rostrate. By banks of brooks in marshy places (Truro), bearing fruit abundantly. Sept.. '80.

I have examined this species very closely, and find no differ-

ence between it and the description and plate of the British species in Berkley. My friend, A. H. McKaye, of Pictou, has found C. Americanum, and thinks all our species are of the latter form.

C. dendroides has been described as occurring in British Columbia and eastern slope of Rocky Mts.

SECT.—Acrocarpi.

ORD.—Bartramiei.

GEN.—Bartramia.

Bartramia, ithyphylla, *Brid.*

Leaves from a sheathing base; lanceolate, rigid, strong nerved, stem dichotomous; sporangium oblique. July, 1880; on granite in elevated places, near Halifax.

ORD.—Bryei.

GEN.—Mnium.

Mnium, rostratum, *Schwæg.*

Stems erect, simple; lower leaves ovate or rounded; upper oblong, obtuse, with an apiculus; margined; simply toothed; fruitstalks aggregated; sporangium oval, pendulous; lid rostrate, very handsome. Growing on sandstone, margins of shady brooks; Truro, '81.

ORD.—Tetraphidei.

GEN.—Trematodon, *Hdw.*

Trematodon, ambiguus, *Hedw.*

Stem short; seta 1 inch, with an apophysis peristorme of 16 lanceolate teeth cleft, but apparently cohering by fine transverse articulations; operculum rostrate, calyptra; cucullate long beaked; leaves oblong, acuminate, concave margins; entire nerve strong excurrent; cells large, oblong at the base; crowded above. Hx., Sept., 1880. — Not described in Berkley's book. An European but not a British species. A. H. McKaye, to whom I submitted specimens, diagnosticated it as above. Not described in Sullivant's Icones., and rare in U. S.; only other Canadian locality, so far given, Kent County, N. B., where it was found by James.

ART. VI.—ARCHÆAN GNEISSES OF THE COBEQUID MOUNTAINS. —MAGNETITIC.—BY REV. D. HONEYMAN, D. C. L., F. S. A., &c.

(*Read March* 14, 1881.)

THE rocks to which attention is directed were first noticed in my second paper on the Geology of the Cobequid Mountains.—Tran. 1873-4, Vol. III, page 385. "South of the County line (Colchester and Cumberland) we have outcrops of the next band. These exposures exhibit much greater variety than was seen on the Intercolonial Railway. In one exposure the strata are beautifully banded. The dark green homogeneous (microscopically) diorites having interbedded red and green gneissoid strata. These exposures show massive homogeneous (microscopically) diorites and others show gneissoid and quartzite strata ; and the

ERRATA.

Page 271 : for "microscopically" read "macroscopically."
Page 273, 7th line from bottom of page, and in page 275 : for "magnetite" read "magnetyte."

The special part of the rocks described in the quotation to which I intend to direct attention, is the "Interbedded red and green gneissoid strata." Specimens of the "red" from a stratum four inches thick were closely examined with a view to satisfying myself regarding the hornblendic character of the dark lines which pervade the red feldspar (orthoclase). Contrary to expectation I found the lines to consist of *magnetite* in grains. A little hornblende and mica also occur. Thinner red strata as well as the green associated, have also grains of magnetite in abundance. The magnet readily and beautifully separates the magnetite from the pulverized rock.

The finding of magnetite in the gneisses in *situ*, led me to

ence between it and the description and plate of the British species in Berkley. My friend, A. H. McKaye, of Pictou, has found C. Americanum, and thinks all our species are of the latter form.

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The finding of magnetite in the gneisses in *situ*, led me to

examine the gneissic boulders in my "Boulder Collection."—Superficial Geology.—*Trans. 1876-7.*

In one boulder from the drift of the west side of McNab's Island, Halifax Harbour, I also found grains of magnetite. The specimen has a decided gneissic structure with the lines much contorted, whereas the lines of the specimens already noticed are sub-parallel. The boulder consists of red orthoclase and green hornblende, with a little quartz and mica. Grains of magnetite are scattered throughout. This boulder is, beyond doubt, from the Cobequid gneisses, having travelled at least 65 miles to reach McNab's Island. The proof of this is to be found in the paper cited.

The occurrence of magnetite in these gneisses enables me to indicate precisely the southern limit of the Archæan formation. The associated diorites extend southward to the bridge above Acadia mines. A northern limit point is evidently the north side of Smith's cutting, Wentworth, I. C. R. Here there is a great development of diorites with porphyrites, instead of gneisses of the south side. This gives the whole Archæan, according to the I. C. R. plans and section books, before me, a width of five miles.

Other Pre-carboniferous Formations.

These occur on both sides of the Archæan, north and south, in the Intercolonial Railway section.

Although the position of the first on either side and apparent sequence might lead to the supposition that the formations correspond, lithology makes a decided distinction. As neither is fossiliferous, palæontology lends no aid, *pro* or *con*, in the correlation of the two.

The lithology and sequence of the formation on the north, Wentworth, side led me, when I first examined the rocks of the I. C. R. section, to recognise a correspondence with a peculiar formation in the Arisaig Mountains, which had caused considerable perplexity on account of its position and peculiarity. It occupies an intermediate position between the Archæan, which I had designated the "Lower Arisaig Series," and the fossiliferous middle and upper silurian, which I had named the "Upper

Arisaig Series." In my paper on the I. C. R., I compared the formation in question to Professor Ramsay's Snowdon and Cader Idris formation, which it seems strikingly to resemble, and adopted the local designation "Middle Arisaig Series."—*Transactions.*

In my examination of the geology of the Eastern Extension Railway, in its course through the Marshy Hope, I found that the south side of the mountain range had lithological characters corresponding with the Cobequid series, as well as the northern side. This is followed, too, by the "Upper Arisaig Series," *Member A*, of the middle silurian age.—Paper, "Notes on a new Geological Progress Map of Pictou County."—Transactions 1879-80.

This led me to consider the mountain formations thus bounded to be of pre-middle silurian—Lower Silurian Age.—Transactions 1879-80.

While the Arisaig and Marshy Hope Mountains and the Cobequid Mountains thus possess so much in common as to make their relationship unquestionable; the "middle Arisaig series" of the former differs from the latter in having a predominance of sub-crystalline rocks.

A fossiliferous series succeeds both. The fossiliferous series of the Cobequids is much different from the "A" member of the "Upper Arisaig series." Its lithology is different as well as the palæontology. Its strata are clayey and soft, while the strata of "A" are quartzoze—often very hard. Igneous rocks—crypto-crystalline diorites and porphyrites—occur frequently, alternating with soft strata in the one, but not in the other.

The only other formation occurring in Nova Scotia which has anything *like* alternating igneous diorites, are the middle silurian magnetites and associate middle and lower silurian strata of King's, Annapolis, and Digby counties.—*Vide* preceding papers. But even these are much different from the fossiliferous and crystalline rocks of the I. C. R. As I have shown elsewhere the palæontology of the strata in question is of the Cincinnati or Hudson River type, while that of A. was regarded by Salter as intermediate silurian. The Cobequid fossiliferous series thus

seems to make the "Middle Arisaig series" of the Cobequids older than the time to which the Type was referred by the Arisaig and Marshy Hope sequence. The Llandeilo period of British Geology is that to which the supposed equivalent of Prof. Ramsay belongs. The combined width of these two lower silurian series is two miles. The formation on the south side of the Archæan in the Cobequids is that which contains the iron deposits of the Londonderry Mines. This is, as far as known, non-fossiliferous. It has heretofore been correlated with the iron bearing formation of East River, Pictou—middle and upper silurian. There seems to be no sufficient reason why they should not now be so regarded.

The strata of this series have a width of one mile. These are succeeded by strata of the lower and middle carboniferous—having a width of three miles. This sequence might lead to the inference that the iron bearing formation is of Devonian age. The two mixed crystalline series on the north side of the Archæan, are also succeeded by carboniferous strata, having a width of seventeen miles; extending to Northumberland Strait. On the south side, the Triassic formation succeeds the carboniferous. This extends to Cobequid Bay; a distance of 4 miles.

It is quite evident from the above that sequence here can not be regarded as a proof of age.

MEASUREMENTS.

The distance between the Cobequid Bay, N., and Northumberland Strait, N., is	32	miles.
The Triassic extends	4	"
Carboniferous	3	"
Upper and Middle Silurian	1	"
Archæan	5	"
Lower Silurian	2	"
Carboniferous	17	"

MAGNETITES.

In a collection of rock and mineral specimens, received at the Provincial Museum from the Rev. Donald Sutherland, of Gaba-

rus, Cape Breton, is one specimen which seems to merit special notice.

The weight of the specimen is $2\frac{1}{4}$ lbs. It is an ore of iron, called by Dana *Magnetite.* It very much resembles some of the magnetites of Nictaux. It is evidently part of a bed in metamorphic rocks. The rocks of the region where it is said to have been found are of lower silurian and pre-silurian age (Archæan).

The specific gravity of the Cape Breton magnetite is....4.3
That of Moose River..............................3.6
Of Blomidon and Extension rocks...................5.0

The Nictaux and Moose River magnetites are of middle silurian age; of Blomidon, post triassic.

Art. VII.—On the Dwellings of the Muskrat and Beaver of Nova Scotia. By J. Bernard Gilpin, A.B., M.D., M.R.C.S.

(Read April 11, 1881.)

The constructive mammals are very few, throughout the world. To say nothing of the burrowers which construct winding holes, or galleries by digging beneath the earth, the most part, are content for a home with what nature gives them; a hollow tree, a den amongst rocks, or a form hollowed by the possessor itself, from the thick grass, is sufficient for their nests, from the strong lion down to the timid hare. And so it was from ancient times, as the bones of the lion and cave bear wrapt with the gnawed relics of their victim, in one stoney mantle, still mark the feasting spot and home of their all but mythic forms. In opposition to this, our Province of Nova Scotia possesses two mammals, each of whom construct dome houses, standing in and out the water still, in our Alpine lakes, and broken streamlets, and which now unseen except by the woodsman, the hunter or Indian, may be readily visited and studied by the naturalist and student. I have thought the members of the Institute would be interested in this paper, in which I have given a few not new facts, but facts old enough, but looked at with new eyes and in perhaps new combinations of scene and climate. The muskrat, (Fiber

zibethicus, Lim.,) is very common over the whole northern part of North America. Formerly he was classed with the Beaver, but lately more justly, with the sub-family Arvicolinæ, or field rat. Still his habits, his tail, and his hind foot so allied to the lobipes in the class of birds, and webbed by ciliated hairs, causes him to stand prominently forward in any classification. But it is of his building habits, I wish this paper to be. In our Province they are divided into those who live in holes, and those who build. The far greater number live in holes ; not from any difference in habit, or form, or species, which I could discover, but from an instinctive adaptation of external circumstances. In running streams connected with our estuaries, they burrow holes in the muddy sides of the stream, the mouths of which are submerged at high tide, and probably bared at ebb. These burrows must slant upwards, so that the extreme end should lie above high-water mark, and here he rudely constructs his sleeping form, lining it with dried grass. The tides are too rapid, and the difference of level between high-water and ebb, too far as well as the angle of the bank-slope too great for him to found a house. Hence though he abounds any where along the deep estuaries of the Province connected with Bay of Fundy tides, his house is rarely seen. A few years ago one stood solitary in Steel's pond, in the suburbs of Halifax, whilst a pair had sought refuge in Griffin's pond on the Halifax common, making no houses, but living in the drains and giving amusement to the many loiterers there about, in watching their fluvial gambols, ending with a dive, preceded by a splash of water caused by a sharp slap of their tail upon its surface. Here we had the dome builders, and the dwellers in holes close before us for our study. I think I saw a dome near Marshal's on the second Dartmouth lake, and again one at Yarmouth. But in all the wide Annapolis valley where they abound, I know none save in Winslow's lake, on the top of the north mountain, as that huge barrier of Triassic trap elevated to about six hundred feet, and bounding the whole north-west or Bay of Fundy edge of our Province, is called. There is a narrow valley in the centre ridge of this whole formation, with hills on either side ; a few

lakes or rather large ponds naturally are formed here from the rains of the adjacent hills, one of which is in Winslow's lake, about four miles from Digby town. This alpine lakelet of about eighty or one hundred acres, hidden by sterile hills of columnar trap, lightly fringed by spruce, fir and pine, scrubby bushes, its shores paved with rugged trap boulders, and its clear waters fringed with rushes, affords a secluded home for the muskrats which have colonized it for years. A wounded scoter unable to rise the hills betwixt the Bay of Fundy and the Digby basin finds his rest there, and an annual flock of spirit ducks (B. albeolæ.) the gaudy purple male, dusky female with obscurely marked young, always during autumn make a halt there. Save an idle boy from the town, or prying naturalist added, no others disturb his quiet. We visited the lake in Nov. 11th, 1880, conveying a canoe over the mountain with us ; a cold November wind was curling its waters into tiny wavelets, and we soon reached their domes ; about twenty yards from shore, in two feet water, and standing amongst the thick rushes and tall grasses. We found cones from two and a half to three feet high, and about four feet diameter, formed of sods of water grass in masses of five or six inches, conical heaps of sodded grass. The lake may have contained from twenty-five to thirty within its borders. The grass they were constructed from was very abundant, growing at the lake bottom, and spread in heaps and festoons, along the lee shores of the lake, being torn by the roots from the shallow waters by the autumn gales. Separated from its sods and wreaths, it resolved itself into distinct rootlets, very fibrous and about three inches long, surmounted by a tussock of grass with leaves about three inches in length. My friend Dr. Somers classified it for me, as (Eriocaulon septangulare Pipeworth). Our canoe was soon grounded upon one of these grass made conical heaps, and my son with his paddle tore off its head. After tearing away about a foot, we came to a cavity roughly formed by the body of the muskrat, lined with grass, and scarcely double his own size. It looked in its careless roughness like the nest of the flying squirrel found often in the interior of a mass of grasses and moss gathered in the forks of a pine tree. Proceeding in our de-

struction, we came to a hole on one side, plunging the paddle into which, we soon came to the waters beneath. Here now was the whole design complete; a dry bed about a foot and a-half above the surface of the lake, covered by about a foot of roof, and having a submarine approach from below, into which the owner entered by diving. The whole cone was solidly constructed from the bottom of the lake, leaving only a narrow hole from the bottom to the nest. The inmate must breathe through the loose top of the cone, as it stands surrounded by water. In another larger cone we pulled to pieces, we found two cavities unconnected with each other, but each having a separate passage to the water below, although the majority were symmetrically conical, yet we found two uneven, one with a perpendicular side, most probably unfinished, as they had not done building for the winter. In building they must place their material on the bottom of the lake, where it soon becomes water sodden, and having a passage open, built up above the surface of the water. They build at night and very rapidly, as one is surprised at seeing cones standing out of the water where none were the day before. November finds them well housed for the winter, and as the ice is never frozen so soon where rushes grow, they no doubt can keep water holes open around them during December, but towards March their houses—the ice often at that period attaining a thickness of two feet and a-half,—are covered by at least two feet of snow. We must suppose that during this period they hybernate as it is impossible for them to reach the surface from beneath the ice; towards the end of April the spring freshets elevate and sweep the ice to the lee side of the lake, carrying with it all their houses, relegating them back to their summer holes, where they breed and raise their young—remaining all summer. Other climates, the warmer ones, where he is said to be common, must modify all his habits, perhaps his building instincts; but in our Nova Scotia variety, we find him almost as marine an animal as the seal, never seeking the land for choice, save for rest, fairly holding his own as the country becomes populous, and getting his dry nest above water, by the strictest and most instinctive means.

Our other constructive mammal, the historical beaver, differs

widely from the muskrat. A far more powerful frame, armed by powerful teeth, more terrestrial in its habits, and constructing larger and more durable houses, and of stronger materials. He constructs on running streams, which he has already dammed across. thus giving to his work a perpetual head of water. It is apart from this paper to describe these dams, accounts of which have come down to us clothed with magnificent exaggeration. Yet no one can stand over and inspect the workman of them as they appear on the small streams of our Province, where the labor is little and the natural obstacles of water flow few, but to confess that the simplest truth is above all exaggeration, and the design of instinct labor, or the appearance of it at least, equal, if not beyond, that adaptation of labor and material to different obstacles to be overcome, that is supposed belong to pure thought. The adaptation of beaver work to broad running streams, narrow streamlets and sluggish water courses, to rocky bottoms, or mud-timbered banks, even still remaining in N. Scotia, is worthy of a paper by itself. Sweeping softly in your canoe over a slight expanse of the many head waters of the Sissiboo river, slowly falling towards the Bay of Fundy, you find the stream tied by a beaver dam some half mile ahead of you, and almost immediately you pass a grey granite rock sloping into the stream. There upon the down stream slope you find a very flattened cone like an inverted saucer of white and peeled sticks in endless confusion, thatching its shallow convex roof. One side, the upper rests upon the grey rock, the other descends beneath the water. This one had two processes, slightly elevated but still thatched, dividing, as it were, the mass entering the water so as to make two ridges running into the stream. The whole was built on the down stream slope of the rock to prevent it being carried away by the ice. Were it not for the milk-white and peeled sticks standing everywhere outwards, it looked like a cart of rubbish shot down a slope. A sweep of the paddle and the canoe grated upon the sticks, and we saw grasses, clay and moss betwixt their interstices. In another dome which we opened from the top by our axes and hands, we cut through two feet of layers of clay, dried hay, a few stones and mosses; we then came to a narrow, sloping shelf edge, around a

central hole. The angle of slope was about fifteen degrees, and about one foot from the water. It was neatly lined with grass, far more neatly than the nest of the muskrat, and the projecting ends of the white sticks into the sides were neatly gnawed smooth. Through the central hole we could see the water flowing beneath. The upper part of the shelf, near the sides of the dome, was much drier and better lined than the edge near the water, which seemed wet and damp. The galleries to the water in this one were two, and though we did not discover them, there must have been towards the rock side air-holes, as no air could come through the two feet of mud thatch. The height of the structure was about three feet; the long diameter about twelve, and the short one about six feet.

Another which I opened in Annapolis County in the head waters of the Allen river, was somewhat larger, and gave greater trouble in breaking open. I put my feet through the opening and stood upon the floor of the internal nest. It seemed so solid beneath me that I supposed it rested partly upon the shelving rock. The structure, both of these domes and the muskrats, will be understood far easier by the sketches and sections I show you. They differ in some respects from the description of Hearne, a most accurate describer, and others. Hearne speaks of them as eight feet in thickness and composed of many cavities, added afterwards to the central nest with which they communicated; other writers speak of double stories. Without for a moment disbelieving their accounts of buildings, modified by differences of climate, and of seclusion, found near the Polar circle, I can only describe the less pretentious dwellings of our own Province, where numbers are less, and complete solitude, bringing with its wants a greater need of concealment, is never found. On the bottom of the stream, near the houses, are narrow and deep grooves in the mud usually formed, these connect with the submarine water galleries. These marine trenches serve, when the water is low upon the stream, for the beavers to swim in without exposing themselves above water, and are, no doubt, caused by their excavating the mud and water grasses in building their domes. They are also very well seen about the muskrat houses. The Indians tell us that their trenches as well as the galleries on the way

to their nests inside are filled with sticks and twigs of various trees, gnawed very short, and dragged below the surface as a store-house of food for the winter, the beavers eating the bark. Indeed, the appearance not only of the thatch of their houses, but of the sticks and twigs of the entire dam, and others lying loosely around, all nicely peeled, well prove the truth of these assertions. Their cream-like color contrasted with the dark greens of the waving grasses, as well as their inextricable interlacing, joined to the trill of the falling waters, through their slender barriers, the lilly pads, coating the stream like a rich carpet, and the back-ground of rugged spruce firs wrapping the whole, as it were, in a frame, form a sylvan scene few forget. Our Indians tell us each house contains about five or six inmates; all trees of the forest serve them in their barks as food, but the poplar wood seem the favorite rather than birches or maples. I have seen very large oaks stumped by them, but it is rare. The roots of the yellow water lily are a very favorite food, and are found growing in abundance around their houses. Though the beaver for its size is an extraordinarily cover-keeping animal, working by night, never seen by fair day-light, his presence is known only by his works; the tree-stumps he leaves, or the houses he constructs, or his dams, sometimes sending back water for two or three miles, and cutting off working water from small sawmills erected in the woods. It is impossible from these prominent signs for him to retain his presence even in a half cultivated country for long. Indian hunters and the idlers will invade his charming home for the skin he wears, now very much fallen in value. I have known the indignant millwright tear up the dam that spoilt his water; a settler waging war with him for flooding his meadows, and even the lumbermen sweep away with axes, the white-peeled, beautifully interlaced brush weir that stayed his log-rafts floating down to salt tide. Hence it is we will not have him long with us; civilization will sweep his wood-gnawed thatch from him, as well as the less-laboured bark wigwam of the Indians, for so many years his idle neighbors. For many years they have become extinct from the eastern parts of the Province, that is, no skins are brought to market from these parts. In 1840, old hunter Hardwicke was supposed to have trapped the

last beaver in Annapolis County. A few years afterwards they recuperated themselves so that there were fifty skins brought to market during one year from one section of country alone, and within a range of twelve miles from Annapolis Royal I visited five of these stations in more or less stages of repair or desertion. They are now diminishing again, and notwithstanding their resolute attempt of holding their own, must inevitably fade away before that army of lumberers who invade their silent homes with crash of axe and loud cry to toiling cattle, and who, worse than all, by artificial dams, alter the level of the inland lakes, so that no sheet of water of any magnitude may be found that has not its waters deepened by dams to create a higher head, which is used at stated times in making artificial freshets, carrying with them the stores of lumber to the sea.

In this paper I have endeavored to put before you the dwellings of our two constructive mammals, the first of aquatic grasses alone, yet a beautiful example of instinctive labour, formed of the simplest materials and nearest at hand, regular cones—reminding us, with their submarine entrance, of the ancient lake dwellings of a prehistoric race, or of the conical ant hills of Africa, and certainly more perfect constructions than those still inhabited by the degraded Melanasian in Australia. The other constructions are of a less perishable nature, and with their dams constructed of timber, oftentimes nearly three feet in diameter, and varied so often by external circumstances that we must allow instinctive, in some cases, to precede skilled labour. No one coming upon the beaver dams still remaining in our forests, seeing heavy timbers felled by gnawing, to fall at a certain point; seeing upright posts standing in the running stream; seeing parallel logs gnawed to certain lengths and interlaced between these uprights, and the boles of living trees on the stream sides; and again, seeing the top horizontal bars loaded with stone to prevent them from floating, but must admit the narrow margin betwixt instinct and reason; and yet I give all these facts as to be seen by the idlers on the stream flowing down the Valley of Annapolis, N. Scotia.

ART. VIII.—THE TRAP MINERALS OF NOVA SCOTIA. BY EDWIN GILPIN, A. M., F. G. S., *Government Inspector of Mines.*

(Read March 7th, 1881.)

WE cannot now say positively who first sailed the Bay of Fundy, but as soon as the attention of the early European adventurers was directed to America we find numerous references to its tides and treasures.

We know, however, that for nearly one hundred years before the early part of the seventeenth century, its shores were visited by numerous daring sailors lured by the charm of the unknown, and the hope that they might acquire fortunes by a lucky discovery of mines of gold and silver.

In the patent granted by King Henry of France in 1603 to DeMonts, he is directed to carefully seek and mark all sorts of mines of gold, silver and copper, the tenth part of which was to be paid in royalty to the King. In 1604, DeMonts, Pontrincourt and Champdor visited Minas, and among other treasures deemed of value, they found at Blomidon great store of jasper, agate and amethyst. A number of these amethysts were carried to France and presented to the King, who ordered the choicest to be cut and set in some of the state crowns and swords. I believe that some of these jewels are still to be seen in the Paris museums, and they form an interesting memorial of those bold spirits who fondly dreamed that they were destined to found a second France on the American continent.

During the same day Champdor visited St. Mary's Bay with a mineralogist, and it is related that they found " pure copper," probably at Cape D'or.

Lescharbot found in 1606 "steel" in the rocks near St. John, which was smelted and made into knives. He also found "marcasite of copper" at LaHave. Writing in 1609, he speaks of the native copper of the Bay of Fundy as being " very pure in the stone," and adds, " many goldsmiths have seen it in France, which do say that under the copper mine there might be a gold mine, which is very probable."

Sir Humphrey Gilbert and others among the more celebrated

of the early sailors, commonly carried in their ships a few "rare refiners of mines."

Passing from these romantic explorers, whose dreams were of empires and gold mines, forts and Governorships, we come down to those who have studied the trap minerals in our own days. Among those may be mentioned Titus Smith, whose views on geological subjects were, for his day, sound and well sustained, although the modern geologist congratulates himself that his beloved study has passed such a rudimentary stage. In 1833, Messrs. Jackson and Alger visited the Bay of Fundy, and collected immense quantities of the trap minerals.

The late Dr. How and Dr. Webster also devoted much attention to this subject, and we are indebted to the former gentleman for many valuable analyses of these minerals and for the discovery of several new species. The labours of the latter are best known to you by the beautiful Webster collection now in the Provincial Museum, and by many specimens presented by him to the Museum of King's College. The study of these minerals also claims its list of martyrs, for a Professor of Acadia, with several students, was drowned in exploring the cliffs of Blomidon.

Their description of the Bay of Fundy minerals has directed the attention of mineralogists to the rich harvests its shore presents, and now there are few cabinets in America or Europe which do not contain specimens from its basaltic cliffs.

I purpose this evening to lay before you a brief outline of the process of formation of the measures related to these minerals, and to give the various analyses, etc., that I have been able to collect from the writings of Dawson, Dana, How and others. I am aware that my list cannot be considered complete, but will feel that the work has not been thrown away if others who have been enabled to devote more time to the study of these interesting minerals will kindly supply the deficiencies of my paper.

I may say to you that a visit to the trap districts of the Bay of Fundy will amply repay the lover of picturesque scenery. From Economy to Five Islands, Parrsboro and Cape D'or, there are presented continuous variations of fertile valleys and rugged cliffs. The shore, composed of strata varying from the almost incoherent triassic sandstones to the granite-like columnar

basalt, has been worn by the fierce tides into every curve and bold outline which can charm the artist's eye.

Those who have wandered under the beetling, forest-crowned cliffs of Blomidon, and watched the tides foaming in the ledges of Cape Split, and bearing in endless circles the luckless coaster who attempts the passage without favoring winds, have enjoyed one of the boldest and most picturesque views on the Atlantic coast, from Florida to the Labradors.

The narrow entrance to Annapolis Basin, the passage of the Islands, and the beautiful little cove that should have been named by a fairy, the site of an ancient crater, adorned by a lake and embowered in mingling verdure of field and forest, luxuriating in its shelter from every rude blast under the protection of encircling hills, all form landscapes which would amply repay the painter's art.

Nowhere on the Atlantic coast do the waves, accumulating before the southerly gales on their unimpeded march across the ocean, burst with more fury and afford a nobler sight than when they encounter the precipitous cliffs of Briar Island. Not unfrequently they maintain so steadily their furious attacks that for several days the unfortunate traveller can solace the tedium of his enforced detention only by watching their masses scattering in clouds of driving spray.

The geology of Nova Scotia presents a great void between the triassic and the boulder clays, so that here we look upon the former as quite a youthful representative of the long geological sequence. We learn that at the time when the deposition of the triassic strata commenced the Bay of Fundy presented an outline closely resembling that of the historical era.

The detrition of the carboniferous rocks surrounding it was effected by tides of great force, not, however, so powerful as those that now excite our curiosity. The fine sand and mud worn away by these tides was deposited in beds which we now see in the valleys of the Annapolis, Cornwallis, Avon and Salmon rivers, and at numerous other points along both sides of the Bay. The manner of their deposition was closely analogous to that now going on outside our dyked lands. These measures, as now exposed, are almost entirely composed of reddish sandstones,

with layers having greenish and purple tints, and have in the lower part beds of conglomerate. The sandstones are soft and not well adapted for the builder's art, although they are sometimes quarried for hearth and chimney stones.

They are frequently traversed by fissures filled with fibrous and translucent gypsum and calcspar, and have, as a rule, a calcareous cement. The presence of these salts of lime is readily accounted for when their abundance in the Lower Carboniferous measures is remembered; their particles carried into the newly formed beds have been dissolved by water and concentrated as veins and masses in the fissures and open spaces.

The soil of these sandstones, enriched by these two fertilisers, and the decomposed ingredients of the volcanic material about to be described, is of an excellent farming quality, so that Cornwallis and the valley of the Annapolis river are justly called the "Garden of Nova Scotia."

While these beds were forming, or shortly after their deposition, great subaqueous outbursts of volcanoes occurred. Enormous masses of scoriæ and dust were poured out and settled in extensive beds; these were succeeded by, or accompanied rivers of lava which rapidly consolidated into the basaltic masses now presented to our view. The history of the succeeding oscillations of level of the trias and its associated trap is not yet ascertained. The denudation has doubtless been very great, and both sandstone and trap have apparently once extended a long distance south of their present boundaries. The foci of these outbursts are still unknown, no systematic examination having yet been made of the courses of the trap, or of the effect of the tides on the submarine beds of scoriæ, etc., while they remained unconsolidated.

The most striking section of these measures can be seen at Blomidon. Here the sandstones dip at an easy angle to the north-west, and are succeeded by an immense bed of amygdaloidal trap, generally of a greyish color, but with tints of red. This bed is full of cavities and fissures holding the minerals to be noticed further on. In places the lower part of the amygdaloid appears to be very intimately mixed with sand, as if it had settled in the unconsolidated strata forming at the moment of

the volcanic outbursts. Above this comes a mass of compact dark, roughly columnar trap.

On the north shore of the Cape of Blomidon the sandstones appear on the beach; as they gradually rise to the south they finally attain a height equal to that of the trap, which by its hardness has preserved them from being washed away. Similar indications of the conformability of the trap, amygdaloid and sandstone are presented at other points, although, as might be expected, the former frequently alternate.

As the tides wear away the sandstones immense masses of the amygdaloid and trap, loosened by the rain and frost, are spread along the shore, and open a rich field to the mineralogist. This noble cliff, 400 feet in height, torn by the storms and frosts of winter, and mantled by trees and shrubs which vainly try to hide its losses, presents, with its dark walls and waving woods, a scene hardly to be expected in our usually tame landscapes.

There is a strong resemblance between the Nova Scotia trap and that which occurs along the Atlantic coast, in strata considered to be of Triassic age, as far as South Carolina. All being of one species and forming varieties of dolerite made up essentially of Labradorite and Pyroxene, with more or less disseminated magnetic oxide of iron, etc. No single analysis or set of analyses could exactly represent the composition of this great mass of rock.

We may first notice the economic minerals found in the rock under consideration:—

IRON ORES.

Magnetite.—This ore is frequently present in the trap, the amount varying in different localities, and may be detected by passing a magnet through the powdered rock. At certain points, among which may be mentioned Digby Neck, St. Mary's Bay and Blomidon, it is concentrated in veins up to a few inches in thickness, frequently associated with amethystine quartz and other forms of silica. The composition of this ore, which is frequently of a very high grade, will appear from the following analysis of a sample from the North Mountain :

Quartz	4.94
Magnesia	4.84
Oxygen	25.19
Metallic iron	65.03
	100.00

Red Hematite.—This occurs in a similar manner as a micaceous ore at many points on Digby Neck and at Cape D'Or, frequently as brilliant crystalline plates in a quartzose matrix. At some points in Hants County it is found in crystals, apparently showing its derivation from Magnetite.

Titaniferous Iron Ore.—This occurs as a sand on the north shore of St. Mary's Bay, apparently concentrated from the trap hills.

The above ores of iron, although of excellent quality, have nowhere been found to exist in quantities which will permit of systematic mining.

Copper.—As already mentioned, this metal is found native at Cape D'Or, Parrsboro', Five Islands and Margaretville, in irregular masses up to 50 lbs. in weight. It presents itself imbedded in the trap, or associated with jasper, zeolites, red copper oxide and carbonate. Operations have been frequently undertaken in the hope of finding deposits suitable for working, but hitherto without success. The occurrence of large and valuable deposits of copper in the Lake Superior trap has naturally raised expectations of similar treasures in this Province. The copper which appears to be derived from the strata with which the trap is associated is not so abundant in the containing measures here as on Lake Superior, and both trap and associated strata are of different age.

So long, however, as the copper continues to be found in plates, masses, etc., attempts will be renewed to prove their value, and it is quite within the possibilities that valuable amounts may be found. Any development in this district will probably be based on a discovery of large masses or layers of the rock containing the copper disseminated in minute grains. At

some localities on Lake Superior, I believe that rock holding one-half of one per cent. of copper is successfully treated by stamping and washing. I am not aware that attention has been directed to our trap with a view of determining if the metal be present under these conditions.

Dr. Dawson mentions the gray sulphuer of copper as occurring at Indian Point.

Antimony. The sulphide of this metal occurs at Margaretville in small quantities in trap.

Our attention is now more partcularly directed to those minerals whose presence in great numbers and beautiful forms has made our trap celebrated among mineralogists. It is stated that Mysore in India alone rivals it in the variety and abundance of its minerals.

These belong to the Fifth division of Dana's mineralogy—oxygen compounds—and may be subdivided into Binary oxygen compounds of the carbon-silicon group—and various subdivisions of the silicate section of the Ternary oxygen compounds.

Oxides of the Carbon Silicon group—series 2.

Quartz. The varieties of this mineral may be divided into two groups. The first comprising all ordinary vitreous quartz, the second the massive flint-like varieties.

First group. *Rock crystal.* This form frequently occurs in trap lining cavities, by itself, or forming a basis for other minerals.

Amethyst. This is found at many places both in the massive state, and in the characteristic crystals. It is frequently found with magnetite, in some cases penetrating it. Its colour varies from a faint violet to deep purple, and is generally considered due to the presence of manganese. But analyses have shown the absence of this element, and the colour has been considered to arise from minute qualities of compounds of iron and soda.

Smoky quartz or *Cairngorm* stone. This occurs with amethyst in the trap, but the largest and best known specimens are from the granite of Paradise, Annapolis County.

Some of the quartz crystals of Nova Scotia are said to show

cavities holding liquids, probably water holding some mineral in solution, or some hydrocarbon compound.

Among the second group may be mentioned—*Chalcedony.* This is a wax-like translucent variety of quartz, frequently found filling fissures in the trap and in botryoidal forms, and containing minute cavities lined by pellucid quartz crystals of almost microscopic size. When of a clear red colour it is called Carnelian. It is also found gray, brown and faint shades of blue and green, and is presented under various names, such as Plasma, Prase, Heliotrope, etc.

In Pliny's time, the Jasper included all these varieties excepting Carnelian.

Agate. This may be considered a variegated chalcedony, the colours being banded, clouded, or due to visible impurities, and are caused by traces of organic matter, iron, manganese, etc. Specimens of great beauty are found at nearly all points along the Bay shore, and sometimes weigh as much as 100 lbs. It is frequently noticed in little veins and strings.

Onyx and *Jasper* also occur abundantly, beside many varieties arising from mixtures of these substances.

Opal. This variety of quartz is a form of lower hardness, lesser specific gravity, and not possessed of capability of crystallization. The precious opal has been occasionally found here, but of small size. When of good colour it forms a valuable jem.

Cacholong is a softer variety frequently occurring as a lining of cavities. Semi or common opal is also frequently met. One common form of the opal is that of the accumulation and partial consolidation by resolution of the silicious shells of infusoria, which consist essentially of opal silica.

Among the Hydrous Silicates we may mention first the Pectolite group of the Bisilicates, represented by—

Laumontite. This mineral is generally flesh coloured, sometimes red, and both massive and crystalline. It is met here at Peter's Point, Port George, Long Point, and at Margaretville coloured green by copper.

The following analysis is by Dr. How, of a specimen from Port George :

SiO_2	Al_2O_3	CaO	H_2O
57·43	21·64	12·07	15·26.

Gyrolite. Found on apophyllite between Margaretville and Port George. The following is an analysis of it :

SiO_2	Al_2O_3	MgO	CaO	K_2O	H_2O
51·90	1·27	·08	29·95	1·60	15·05

Centrallasite. This mineral, regarded as a variety of Okenite, occurs with Cyanolite and Cerinite in amygdaloid. It is of a radiated and lamellar form and of a whitish colour with pearly lustre.

The following is the composition of a Nova Scotia specimen:

SiO_2	Al_2O_3	MgO	CaO	K_2O	H_2O
1·86	1·14	·16	27·92	·59	11·42

Cyanolite. Amorphous of a bluish gray colour, and little lustre —occurs at Black Rock and vicinity. The following analyses are by Dr. How :

SiO_2	Al_2O_3	CaO	K_2O	H_2O
74·15	·84	17·52	·53	7·39
72·52	11·24	18·19	·61	6·91

Dana remarks that it is probably the same as Centrallasite but impure with silica, or it is the same mineral with Chalcedony.

Louisite. This, the latest addition to our list of trap minerals, may be inserted here. Its colour is leek green, translucent with vitreous lustre.

The following analysis is by Mr. H. Louis :

SiO_2—Al_2O_3—FeO—CaO—MgO—K_2O— Na_2O—H_2O

63·74— ·57— 1·25—17·27— ·38—3·38—3·38—·08—12·96

It is apparently intermediate between the two last named minerals, and may perhaps be considered a variety of Okenite.

Chrysocolla. A silicate of copper holding water and iron is occasionally found as an incrustation.

The *Unisilicates* are represented by the Calamine and Apophillite groups.

The first group is represented by

Phrenite. A hydrated silicate of alumina and lime holding iron, occurring as firm, hard encrusting masses usually mamillated ; among the localities yielding it may be mentioned Black Rock.

The second group is represented by

Apophillite. This mineral has been found at the same localities as Laumontite, and also at Chute's Cove, Swan's Creek, and Blomidon. It is presented both massive and crystalline, with white, red and green colours, and associated with zeolites. It is named from its exfoliation before the blow-pipe flame, and is also called fish eye from its resemblance to the eye of a boiled fish.

The following analysis of a Nova Scotia specimen is by Keakirt :

$$SiO_2 \;—\; CaO \;—\; K_2O \;—\; FeO \;—\; H_2O$$
$$52{\cdot}60 \;—\; 24{\cdot}88 \;—\; 5{\cdot}14 \;—\; 1{\cdot}71 \;—\; 16{\cdot}67 = 101{\cdot}00$$

The *Zeolite* section of the hydrous silicates however claims most attention. Dana divides them into eight groups, and remarks that the resemblance to the Feldspar group in oxygen ratios seems at first thought to imply resemblance in the scheme of composition at least. But there is wide divergence of crystalline form and physical character, while these points are grounds of unity in the Feldspar group. The water present has produced a wide divergence from the Feldspars, and it is therefore probable that it is in part at least basic.

They are composed essentially of silica and alumina with some alkali and more or less water, and generally gelatinise in acids.

1. *Mesotype group.*

Thomsonite. This occurs at Peters Point, and North mountain of Kings Co., in long and slender crystallisations of a grayish white colour, and as globular masses of radiated and interwoven crystals.

Mesole. This variety occurs in sperical concretions a few miles west of Blomidon. The following analyses are of Nova Scotia specimens :

SiO_2	Al_2O_3	CaO	Na_2O	H_2O	K_2O		
41·26	29·60	11·71	5·29	12·63	——	=100·59	How.
41·64	30·52	9·21	4·95	13·11	·44	= 99·87	Marsh.

Natrolite. This occurs at Gates mountain, Cape d'Or, Two Islands, etc., often in bunches of transparent crystals. The following analyses are by Prof. Marsh:

	SiO_2	Al_2O_3	CaO	Na_2O	K_2O	H_2O.
(1)	46·84	27·19	·24	14·89	1·50	9·79.
(2)	48·43	28·38	—	14·23	1·16	10·11.

(1) Five Islands. (2) Cape Blomidon.

Scolecite, so called from its curling up like a worm before the blowpipe, also occurs with the above-named minerals.

Mesolite is found in the North mountain of Kings Co., and Gates mountain with Farœlite, in masses up to the size of a man's head, usually having the interior of fine pibrous radiated and somewhat plumose crystals.

	SiO_2	Al_2O_3	CaO	Na_2O	Ka_2O	H_2D.	
(1)	46·66	26·48	9·63	4·83	——		How.
(2)	46·71	26·48	9·55	5·68	——		"
(3)	45·89	27·55	9·13	5·09	·48		Marsh.
(4)	45 39	28·09	7.55	5'28	·49		"

(1) & (2) Gates mountain. (3) Blomidon. (4) Sandy Cove.

1. *Levynite group.*—Not represented here.

3. *Analcite group.*—Represented in Nova Scotia by the mineral of the same name.

Analcite—So called from its weak electric power when heated. It is found at Martial's Cove, Five Islands, Cape D'or, Swan's Creek and McKenzie Head, as trapez ohedrons. It is generally presented in crystals in amygdaloid, sometimes an inch in diameter. A curious variety is described by Dr. Jackson, as occurring on the south shore of the Bay of Fundy. The crystals were verdigris green outside, and paler green within, from holding 2 to 3 per cent. of carbonate of copper. It is sometimes found attached to plain cuts of copper holding it to the rock or suspending it in cavities.

4. *Chabazite Group.*

Chabazite. This is one of the most characteristic of our trap minerals, and occurs usually in rhombohedrons of gray or wine-colour tints, with Heulandite, Analcite, and Calcite at Five Islands, Swan's Creek, Mink Cove, and Williams Brook. This mineral occasionally contains Baryta, and Strontia.

The following are analyses of specimens from Parrsboro':

$Si.O_2$—$Al_2.O_3$—Ca. O—$Na_2.O$—$K_2.O$—$H_2.O$—Fe. O

51·46—17·65—8·91—1.09 — ·17 —19·66— ·85 Hoffinan.

52·14—19·14—7·84— ·71 — ·98 —19·19— — Ramelsberg.

Acadialite is a reddish coloured variety, so named from its having been first found in Nova Scotia. In some specimens the colouring matter is arranged in layers and bands in the body of the crystals.

The following analyses are by Hayes :

$Si.O_2$ — $Al_2.O_3$ — Ca. O — Na. O — K. O — $H_2.O$

52·02 — 17·88 — 4·24 — 4·07 — 3·03 — 18·30

52·20 — 18·27 — 6·58 — 2·12 — —- — 20·52

The difference being chiefly in the greater amounts alkalies and lessened percentage of lime in the latter mineral. Among the localities yielding it most abundantly may be mentioned Two Islands.

Gmelinite. This species is not very common here, it being met principally at Blomidon (as Ledererite) and on the north shore nearly opposite Cape Sharp, in geodes with analcite, and frequently implanted on quartz.

Ledererite (mentioned above) is ordinary Gmelinite impure with free silica. Marsh has shown that it does not differ in the percentage of water, and Descloiseaux that its crystalline angles are the same.

The following analyses by Prof. Marsh are of specimens from the vicinity of Cape Blomidon. The two first show an excess of silica due to visible quartz which was separated in the third analysis:

$Si O_2$	$Al_2 O_3$	$Ca O$	$Na O$	$K O$	$H_2 O$
53·71	17·63	6·52	3·10	·80	17·98
51·32	18·45	6·41	——	3·48	20·35
47.19	20·13	7·44	3·54	·91	20·53

5. *Phillipsite Group.*

This group as represented by Phillipsite is reported to have been found in this Province, but I have not seen any specimens myself. It is well known as showing beautiful cruciform crystals, of three twinned prisms crossing each other at right angles.

6th. I am not aware of the occurrence of members of the 6th or Harmotome, or of the 7th, or Stypostilbite, groups among our Nova Scotia varieties.

8th. *Stilbite group.*

Stilbite.—This is the most common of our trap minerals. Its colours usually white and lustrous, whence its name, and it is presented in sheaf-like, lamellar and radiated forms. At Partridge Island it occurs as a perpendicular vein from three to five inches wide and 50 feet long, intersecting amygdaloid. Also found at Isle Haute, Gulliver's Hole, Digby Neck, Black Rock, Hall's Harbor, Blomidon, etc.

Epistilbite. — This variety occurs in small reddish crystals, nearly or quite opaque, at Margaretville, associated with stilbite.

The following analysis are of specimens from this locality :

$Si O_2$	$Al_2 O_3$	$Ca O$	$Na O$	$K O$	$Fe O$	$H_2 O$	How
58·57	15·34	7·00	·99	·99	1·58	15·42	"
58·35	16·73	7·87	2·10	——	——	14·98	"

Heulandite.—This mineral occurs at Peter's Point in white and reddish colours, with Laumontite, Apophyllite and Thompsonite, also at Blomidon and Black Rock in crystals, colourless and flesh-coloured, frequently an inch and a half long, and at Two Islands as yellow crystals, and at the localities mentioned under the head of Stilbite.

Cerinite is of a similar composition, but massive with waxy

lustre. It was first described, I believe, by Dr. How, who gave the mean of two analyses:

$$SiO_2 — Al_2O_3 — HO — \text{Mglod.} — CaO \quad KO \quad H_2O$$
$$57{\cdot}57—12{\cdot}60 — 1{\cdot}14 — 1{\cdot}87 \quad — 9{\cdot}82 — {\cdot}37—15{\cdot}69$$

It has been noticed forming the thin outer crust of amygdules in trap near Black Rock.

Mordenite.—This mineral, also a discovery of Dr. How, occurs near Morden in trap with Apophyllite, Barite, and a Phrenite like mineral, also with Gyrolite at Peter's Point, eight miles west of the preceding locality.

The following is his analysis:

Silica — Alumina — Lime — Soda — Water.
68·40 — 12·77 — 3·46 — 2·35 — 13·02

It is presented in small cylindrical and reniform masses, with a whitish yellow and pink colour. It is the most highly silicated of the Aluminous non magnesian hydrous silicates, yet described.

Steelite.—This variety occurs at Cape Split, and is so well defined that it is proposed to give it a place as a variety of Mordenite.

Among the better known minerals, outside the zeolite, may be mentioned:

Chlorophœite, a dark green to brown mineral, found imbedded but generally as a lining in cavities.

Delessite, or Ferruginous Chlorite, has been reported from Partridge Island, where it is said to fill cavities in the amygdaloid.

Glauconite.—This hydrous silicate of iron and potash, belonging to the class found in cavities in eruptive rocks, occurs at several points.

Gypsum.—This mineral occurs fibrous, massive and foliated, at numerous localities.

Calcspar is frequently met with. Fine specimens are met as rhombohedral, white-yellow crystals, and as dog-tooth spar, at Partridge Island, Two Islands and Black Rock.

Barite is also met accompanying many of the above mentioned minerals, in the massive, lamellar and crested forms.

ART. IX.—THE ICE STORM OF JANUARY, 1881, BY H. S. POOLE, F. G. S.

THE ice storm of January 24th, 1881, was so unusual for Nova Scotia, that it is, perhaps, worthy of note.

On Friday, three days before, an ordinary silver thaw covered the bushes with the well-known casing of ice that so attractively glistens in the morning sun, and where cracked refracts the bright rays into all the colours of the rainbow. On the following day a mist with occasional showers of rain, freezing as it fell, added to the icy coating and bent the tops of trees with its weight. The accumulation of ice on buildings, fences, telegraph posts and wires was then sufficiently heavy to cause remark, but the atmospheric conditions necessary for such an ice growth continuing, the coating grew thicker, and increased with telling force on all slender trees and wide spread branches.

On Monday the showers returned, and they seemed to sweep across the country with alternate bodies of colder air, at least it seemed so, for when driving along the country roads one was met at one moment by gusts of hail, and the next by rain. Roads that were traversed without difficulty in early morning became within a few hours so obstructed with bowed and broken trees as to be almost impassable.

Having read of similar storms in Russia, the phenomena produced were watched with more than ordinary interest, and especially, were the curious forms taken by the ice coating the telegraph wires. At first the wires appeared merely increased in size—the ice forming on the top of the wire and on the side exposed to the storm, which came from the north-east. The showers next formed icicles, which in their turn offered further surface for accretion. But the icicles did not long hang vertically from the wires, for the accumulations on the top overcoming the adhesion to the wire slowly turned round until they were underneath, and the icicles made to take various angles, some rows being even reversed and vertical. On some sections other rows

of icicles formed pendent from the wires, or from the points of the first, but at fresh angles.

The weight of the ice coating was so great that it broke the wires in many places; its surface was uneven, averaging in its greater diameter over an inch in thickness, and in the lesser diameter about three quarters of an inch; the icicles first formed stood about an inch and a half apart, and were about two inches long, and up to three quarters in thickness; the second formation of icicles were longer and slighter. This ice remained on the wires for days, and when it became detached, as it did in places, it was interesting to note that it slowly sagged or beat down as its crystalline structure reformed under the pressure of its own weight.

One phenomenon in connection with this storm has yet to be told. The bending of the trees beneath the weight of ice that formed upon them has been mentioned. It might be added that whole groves of young birch bent over until their tops became attached to the snow beneath, even trees of fifteen and twenty inches in girth succumbed to the weight and bent to the ground. On Monday, about noon, the wind had ceased, and no other sound was to be heard than that of the steadily falling rain, except when the weight of fast forming ice overcame the strength of some tree top or branch, and with clashing ice-laden twigs it slowly bent over or more rudely snapped with loud report. So frequently did this occur that one stood in open spaces eagerly watching to catch the first rustle that foretold the destruction of some sturdy tree that broke rather than yield to the overpowering weight. Simultaneously over a large tract of country was this noticed, and lumberers from Middle Musquodoboit reported that there at the same hour the woods resounded with the sounds of crushing trees and falling branches.

NOTE TO MR. POOLE'S PAPER ON THE ICE STORM OF JANUARY 24, 1881.

In the latter part of May I was passing up the Valley of the East River of Pictou, and on the road beyond Hopewell Station,

from which I started, met with the first signs of the result of the described ice storm, many trees being denuded of their tops and branches, and numerous small trees being still in a bent position; but as higher ground was reached the trees were not broken or torn, showing that snow, and not rain, had fallen upon them, nor was there anything in the trees on the cross road between the upper part of the East River and the west branch of the St. Mary's, nor upon the head waters of the Liscomb River, which showed that the ice storm had there prevailed. My driver from Caledonia Settlement to St. Mary's informed me that he had been in the woods on the Lower Liscomb during this storm, lumbering, and he, as well as other men, were afraid to leave their camp in consequence of falling limbs rendering it dangerous to do so.

Returning up the east branch of the St. Mary's river the effects of the storm were strongly visible, a great number of trees having suffered from the weight of their unusual burden, large limbs of birches and other trees, some fully six inches in diameter, being broken off close to the stems. In this district small trees were bent to the earth by the weight of the ice, and the roads were for a day or two, or until the trees were cut off, impassable. On this branch of the St. Mary's after the storm, the scene when the sun shone on the ice-laden trees must have been exceedingly beautiful, particularly on the borders of the long lake through which St. Mary's River flows.

R. MORROW.

ART. X.—LICHENS OF NOVA SCOTIA. BY A. W. MACKAY, B.A. B. SC., PRINCIPAL OF PICTOU ACADEMY.

(Read May 9, 1881.)

LICHENOLOGY is the botanical field of romance, in it tales are told of beautiful blue and green algals under the tyrannous grasp and mastery of fungi which live upon them and cannot live without them. From the researches of DeBary, Famintzin, Baranetzky, Schmendener especially, Barnet and Reese, a lichen

appears to be a compound plant consisting of a parasitic fungus infesting, enveloping and modifying an algoid host. The *fungus* is the dominant element, the *alga* is the omnipresent *gonidial layer* of the older lichenologists.

The reproductive system of the lichen is essentially fungoid *ascomycetous* group. The *gonidia*, on the other hand, have in many cases been shown to be a species of algæ ; analytically, by freeing them from the investing fungi, when they develop into well known forms of algæ ; synthetically, by sowing the spores of a lichen ; fungus on an appropriate species of algæ ; when a genuine lichen-thallus is produced.

According to Schwendener, Peltigera, Pannaria, Leptogium and Collema are ascomycetous fungi parasitic on species of the *Nostocaceæ* ; Graphis and Verrucaria on *Chroolepidæ ;* Uonea, Evernia, Physcia and Cladonia on a species of *Palmellaceæ.*

Lichens are found everywhere, and they can be preserved in the Herbarium with the least possible trouble. These facts should be a great stimulus to collectors. Many of them can also be easily determined with nothing more than the assistance of an ordinary lens ; although among the crustaceous and pustular species in particular, high powers are required to make out the characters of the reproductive organs upon which the classification is based.

In the following pages, I give, at the request of our honored President, simply, a list of species with the localities in which they have been observed. It will be seen that my work in this department has been nearly exclusively, as yet, confined to western Pictou. There are two or three doubtful species included and so marked, several others are withheld.

Lichens of Pictou, *et al.*, Nova Scotia. (Provisional list, arranged according to Tuckerman's *Genera Lichenum.)*

TRIB. I.—PARMELIACEI *(Fr., Eschw.) Tuck.*

FAM. 1.—USNEEI, *Fr.*

GEN. I.—RAMATINA, *Ach. DeNot.*

1. *R. calicaris, Fr.* Common on trees, old fences, &c., Pictou. Also, *var. fastigiata, Fr.* and *var. farinacea, F.*

2. *R. pusilla, Poir.* Not common on forest trees, Pictou.

GEN. II.—CETRARIA, *Ach., Fr.*

3. *C. ciliaris, Ach.* Common on old bark, P.

4. *C. lacunosa, Ach.* Frequent on old hemlock bark, North Dalhousie. Pictou.

Var. Atlantica Tuck. Frequent on withered twigs of *Coniferæ*, Pictou.

5. *C. glauca Ach.* Common on old fence logs, &c., Pictou.

6. *C. juniperina, Ach.* Rare. On twigs of some *coniferæ*,

GEN. III.—EVERNIA, *Ach., Mann.*

7. *E. prunastri Ach.* (?) Very rare. On dead wood, Pictou.

GEN. IV.—USNEA *(Dill.) Ach.*

8. *U. barbata, Fr.* Very abundant. On coniferous trees, etc.

var. florida, Fr. Common, Pictou.

var. dasypoga, Fr. Not uncommon, P.

GEN. V.—ALECTORIA, *Ach., Nyl.*

9. *A. jubata, Fr.* Common on dead dead wood, Pictou.

var. chalyheiformis, Ach. On fence logs, Pictou, common on portions of the Magdalen Islands.

FAM. 2.—PARMELISI.

GEN. VI.—THELOSCHISTES *(Norm.) Tuck.*

10. *T. parietinus (L., Duff.) Nyl.* Very common. On northern exposure of neglected wooden buildings, on fences, trees, &c. Pictou.

GEN. VII.—PARMELIA, *Ach., De Not.*

11. *P. perforata Ach.* On maple trees, Pictou.

12. *P. perlata, Ach,* (?) On maple trees, North Dalhousie, Pictou.

13. *P. tiliacea, Ach.* On trees, Pictou.

14. *P. Borreri, Ach.* On spruce trees, Pictou and Truro.

15. *P. Saxatilis, Ach.* Common on old fences, trees and rocks, Pictou.

16. *P. Physodes, Ach.* Very common on trees, &c., Pictou.

17. *P. caperata, Ach.* On old bark, on trees, Pictou.

18. *P. conspersa, Ach.* On granite boulders, N. W. Arm, Halifax and Pictou.

19. *P. ambigua, Ach.* On trees, Pictou.

20. *P. olivacea, Ach.* Very common on bark of trees, Pictou.

GEN. VIII.—PHYSCIA (*D.C.*) *Fr.) Th. tr.*

21. *P. stellaris (L.) Nyl.* Common on trees and sometimes on rocks, Pictou. Also, *var. hispida, Fr.* On trees and rocks, Pictou.

22. *P. obscura, (Eboh.) Nyl.* On trees, North Dalhousie, Pictou ; Truro.

FAM. 3.—UMBILICARICI.

GEN. IX.—UMBILICARICI (Hoffm.)

23. *U. pustulata, Hoffm.* On rocks. Bedford and North West Arm, Halifax.

24. *U. Dillenii, Tuck.* On rocks, North West Arm, Halifax.

25. *U. erosa, Hoffm.* On a granite boulder, Pictou.

26. *U. Michlenbergii, Ach.* On rocks, Bedford, N. W. A., Halifax.

FAM. 4.—PELTEGEREI.

GEN. X.—STICTA (*Schreb.*) *Delis., Fr.*

27. *S. crocata, Ach.* Rare. On elm trees in intervale, North Dalhousie, Pictou. Very pretty.

28. *S. pulmonaria, Ach.* Very common, on trees. Pictou.

29. *S. scrobiculata, Ach.* Not uncommon, on trunks of trees, Pictou.

30. S. *glomerulifera, Delis.* Frequent on maple trees, Pictou.

GEN. XI.—*Nephroma, Ach.*

31. *N. laevigatum, Ach.* With mosses on damp rocks, N. W. Arm, Halifax.

GEN. XII.—PELTIGERA (Willd., Hoffm.) Fee.

32. *P. aphthosa, Hoffm.* Common with mosses on shady moist banks in the wood. Pictou.

33. *P. canina, Hoffm.* Frequent ; with the preceding. Pictou and Halifax.

34. *P. polydactyla, Hoffm.* Not rare. Found in situations similar to those of *aphthosa* and *Conina*, Pictou.

FAM. 5.—PANNARIEI.

GEN. XIII.—PANNARIA (*Del.*) *Tuck.*)

35. *P. hypnorum, Fr.* On decaying mosses, North Dalhousie, Pictou.

36. *P. triptophyalla, ch.* (?) On bark of a maple tree, North Dalhousie, Pictou.

37. *P. brunnea (Sw.) Mass.* On the ground, Pictou.

FAM. 6.—COLLEMEI.

GEN. XIV.—COLLEMEI (*Hoffm.*), *Fa. Fe.*

38. *C. leptalium, Tuck.* On trees, North Dalhousie, Pictou.

39. *C. flaccidum, Ach.* On trees, Pictou.

40. *C. nigrescens (Huds) Ach.* On trees, North Dalhousie, Pictou.

GEN. XV.—LEPTOGIUM, *Fr. Nyl.*

41. *L. tremelloides, Fr.* On trees, North Dalhousie, Pictou; N. W. Arm, Halifax.

42. *L. myochroum (Ehrh.) Schær). var. saturninum (Dicks), Tuck.* On trees, North Dalhousie, Pictou.

FAM. 7.—LECANOREI.

GEN. XVI.—PLACODIUM (D.C.) *Naeg & Kopp.*

43. *P. vitellinum. Eboh.) Ach.* On granite boulders, Pictou.

44. *P. cerinum, Ach.* On trees, North Dalhousie, Pictou.

45. *P. aurantiacum (Lightf.)* Not uncommon on trunks of willows and poplars, North Dalhousie, Pictou; and on old board fences, Pictou.

GEN. XVII.—LECANORA, *Ach.*

46. *L. rubina, Ach.* (?) On exposed dead wood, Pictou.

47. *L. pallescens, Fr.* On hemlock bark, Pictou.

48. *L. subfusca, Ach.* Very common. On bark of trees everwhere.

49. *L. Hageni, Ach.* On exposed and weathered bones, shore of Pictou Island. On calcareous boulders, Pictou.

50. *L. Pallida, Schær.* On bark of maple, North Dalhousie, Pictou; common.

51. *L. varia, Fr.* On weathered wood and boulders, Pictou. Also, *var. polytropa. Fr.*

52. *L. albella, Ach.* On bark of maple, N. Dalhousie, Pictou.

53. *L. elatina, Ach.* On old bark, Pictou. Also,
var. ocrophæa, Tuck.

54. *L. cinerea, (L.)* On granite boulders, Pictou. Also
var. discreta, Fr.

55. *L. cervina (Pers.) Smf.* On boulders, Pictou.

GEN. XIX.—RINODINA. *Mass. Stitz.*

56. *R. sophodes (Ach.), Mass.* On bark of trees, North Dalhousie, Pictou. Also,

var. polyspora. (Th. Fr.) Pictou.

GEN. XX. — PERTUSARIA, D. C.

57. *P. pertusa, Ach.* Common; on bark of trees, Pictou.

58. *P. leioplaca, Ach.* Not uncommon; on bark of trees, Pictou, Halifax.

59. *P. velata, Turn.* Common on bark of trees, Pictou.

GEN. XXI.—CONOTREMA, *Tuck.*

60. *C. urceolatum, Tuck.* Not rare; on bark of trees (maple) Pictou.

GEN. XXII.—THELOTREMA, (ACH.) *Eschw.*

61. *T. lepadinum, Ach.* On all bark of trees, N. Dal., Pictou.

TRIB. II. — Lecidiacei. (Fr.)

FAM. I.—CLADONIEI *(Zenk., Kbr.) Th., Fr.*

GEN. XXIII.—STEREOCAULON, *Schær.*

62. *S. tomentosum, Fr.* On boulders. P.

63. *S. corralloides, Fr.* On boulders. P.

64. *S. paschale, Laur.* Common; on rocks and boulders. Pictou.

65. *S. condensatum (Laur).* On granite boulders. P.

GEN. XXIV.—CLADONIA, *Hoffm.*

66. *C. pyxidata, Fr.* On decaying wood. P.

67. *C. fimbriata, Fr.* On decaying wood. P.

var. radiata, Fr. Also.

68. *C. gracilis, Fr.* On decaying wood and vegetable mould, Pictou and Halifax.

69. *C. turgida, Hoffm.* On a ridge of gravel, called "Boar's Back," Pictou.

70. *C. furcata, Flk.* On the ground Pictou, Halifax.

71. *C. squamosa, Hoffm.* Very common; on decaying wood Pictou.

Var caspiticia. Decaying wood. P.

72. *C. rangiferina, Hoffm.* Very common; on ground P., Hx.
Var. alpestris. Also, Pictou.

73. *C. uncialis, Fr.* On the ground N. W. Halifax.

74. *C. cornucopioides, Fr.* On decaying wood and mould, Pictou.

75. *C. macileuta, Hoffm.* On decaying wood, Pictou.

76. *C. cristatella, Tuck.* On decaying wood and vegetable mould; common.

FAM. 2.—LECIDEEI.

GEN. XXV.—BÆOMYCEE, *Fee.*

77. *B. roseus, Pers.* Very common; on barren ground, Pictou.

78. *B. byssoides, Fr.* On granite boulder in shade, N. Dal. and Pictou.

79. *Æruginosus, Scop.* On decaying wood in shade, Pictou.

GEN. XXVI.—BIATORA, *Fr.*

80. *B. decoloranzs, Fr.* On ground, N. Dal., Pictou.

81. *B. vernalis, Fr.* On calcareous boulders, Pictou.

82. *B. exigua (Chaub), Fr.* Common; on bark of trees, N. Dal. and P.

83. *B. atropurpurea, Mass.* On bark of trees, Pictou.

84. *B. rubella, Fr. Var schweinitzii, Tuck.* On bark of trees Pictou.

85. *B. umbrina, Ach.* On granite boulders, Pictou.

86. *B. chlorantha, Tuck.* On hemlock bark, N. Dal., P.

GEN. XXVII.—HETEROTHECIUM (H). *Tuck.*

87. *H. pezzizoideum, (Ach.) H.* On birch and hemlock bark, N. Dal., P.

88. *H. grossum (Pers). Tuck.* On bark of trees, Pictou.

GEN. XXVIII.—LECIDEA (*Ach., Fr.*)

89. *L. contigua, Fr.* Common; on stones and rocks, N. Dal. and P.

90. *L. melanchheima, Tuck.* On old weathered wood, Pictou.

91. *L. spilota, Fr.* On rocks, N. W. Arm, Hx.

GEN. XXIX.—BUELLIA *(DeNot). Tuck.*

92. *B. parasema* (*Ach.*), *Kbr.* Common; on bark, wood and stone, Pictou.

93. *B. Petræa, Fl. Tuck.* On granite boulders, Pictou.

TRIB. III.—Grapidiacei *(Eschw., Nyl.)*

FAM. I.—OPEGRAPHEI. *Stitz.*

GENS. XXX.—OPEGRAPHA *(Humb). Ach., Nyl.*

94. *O. varia (pers.), Fr.* On the bark of the maple, Pictou.

XXXI.—GRAPHIS. *Ach., Nyl.*

95. *G. scripta, Ach.* Common; on birch and hemlock bark Pictou.

FAM. 2.—ARTHONIEI. *Kbr.*

GEN. XXXII.—ARTHONIA. *Ach., Nyl.*

96. *A. patellulata, (Nyl.)* Rare; on bark of trees, Pictou.

TRIB. IV.—Caliciacei.

FAM. 1.—SPHÆROPHOREI.

GEN. XXXIII.—SPHÆROPHORUS. *Pars.*

97. *S. globiferous (L), D. C.* Common, especially on the rough bark of the trunks of *Abies Canadensis*, Pictou and North Dalhousie, P.

FAM. 2—CALICIEI.

GEN. XXXIV.—ACOLIUM *(Fee.) DeNot.*

98. *A. tigilare (Ach.) DeNot.* On weathered wood, fence palings, Pictou.

GEN. XXXV.—CALICIUM, *Pers., Ach., Fr.*

99. *C. lenticulare (Hoffm, Ach.)* On weathered wood, North Dalhousie, Pictou. Rare.

GEN. XXXVI.—CONIOCYBE, *Ach.*

100. *C. furfuracea (h) Ach.* Found growing on the roots of an overturned tree in a moist spot in the forest: Carriboo, Pictou.

TRIB. V.—Verrucariacei *(Fr., Fee). Stitz.*

FAM. 1.—VERRUCARIEI.

GEN. XXXVII.—VERRUCARIA *(Pers.) Tuck.*

101. *V. maura (Wahl), Th., Fr.* Sandstone rocks on seashore, Cape John, Pictou Co.

102. *V. rupestris, Schrad.* Conglomerate rocks, N. Dal., Pictou Co.

GEN. XXXVIII.—PYRENULA (*Arch., Nœgke, Nepp. Tuck.*)

103. *P. punctiformis* (*Ach.*), *Neg.* On the bark of maple trees, N. Dal., P.

104. *P. glabrata* (*Ach.*) *Mass.* On the bark of the birch, N. Dal., P.

ART. XI.—NOTES ON THE GEOLOGY OF POINT PLEASANT. BY A. CAMERON.

FORMATIONS.

The formations described in these notes may be stated thus:

I. Cambrian Metamorphic, belonging to the great gold formation of Nova Scotia.

II. Post Pliocene, or glacial drift.

ROCKS.

I. *Cambrian Metamorphic.* The rocks of this series are slates, which extend over the whole peninsula.

The first exposure we notice is at the old "Lime Kiln," Pleasant Street. In this we note the following points:—

1. Lines of bedding.
2. Slaty cleavage.
3. Jointed structure, result of metamorphism.
4. That the dip is to the south, and the strike approximately east and west.

In the shore exposure of the bank below the old three gun battery we find the most interesting exposure of the series. Before we reach this the strata dip regularly to the south, but here we find the strata much disturbed, and just a little to the south we find the synclinal axis, with strata having northerly and southerly dips, the argillite strata in the middle being bent, the lines of strata being shown by a number of parabolic curves. Proceeding farther to the south we find the series dipping regularly to the north.

LIFE OF PERIOD.

No remains of life have been found in these rocks. On "Black

Rock " are marks, supposed to have been made by Annelids, are seen. The tracks are called Helminthites.

GLACIAL DRIFT.

The most interesting subject connected with the geology of this district is the glacial drift. There is a beautiful example of striation in rear of Prince of Wales' Tower. The lines are distinctly marked and remarkably uniform in direction. The average course of a number measured is S. 20 ° E. A very few have a different course, S. 35 ° E.

COURSE OF STRIATION.

That the direction was from north to south may be inferred in the following way:

We notice several deep grooves which abruptly break into small ones. These keep the same course as the larger ones. Now it is much more likely that the "graver" was broken and formed a uniform large one. Hence we infer that the course was from the larger towards the smaller grooves.

Following the course of striation we reach the shore near the N. W. A. Battery, and proceed to examine the bank below the old fort. One of the most interesting objects to be seen here is a large quartzite boulder, a scarred veteran, of the glacial drift, bearing the marks of the difficulties it has gone through, on its face. That it has been moved over another stone surface can easily be seen. We see on it a sharp edge that has been produced by being rubbed first one side and then the other on another surface. The lines of abrasion are quite distinct. The boulder weighs over half a ton.

DRIFT ROCKS.

The drift rocks collected here include Gneises, Granites, Sijenites, Diorites, Quartzites, Porphyries, Schists and Amygdaloids. The region they have come from is the shores of the Bay of Fundy. The magnetic course of striation, as we have have seen, is S. 20 ° E., which added to 20 ° var. gives a direction of 40 ° from the true meridian, This just grazes Blomidon. They have come from here or from some point on the shore of Cobequid Bay and in the Cobequids as far east as Economy Point, the

Londonderry Iron Mines and I. C. Railway at Blomidon and in the Cobequids we find the rocks *in situ*.

Art. XII.—Notes on the Geology of Bedford, Sackville and Hammond's Plains. By Alfred Hare.

Read May 9, 1881.

During the course of the last Session, I have been engaged in an examination of the rocks of Bedford, Sackville, and Hammond's Plains, on the days that were not class days. I found three formations, namely Archæan, Cambrian and Pleistocene.

1. Archæan.

The Archæan or what is believed to be Archæan, extends from the Birch cove lakes westward, crossing the Margaret's Bay road about three quarters of a mile below Pulsifer's and continues to below Wright's lake, westward to Saint Margaret's Bay. I have not followed it any further. The granite appears to be unstratified. It is very feldspathic ; some of the crystals of feldspar are very large, so that we are quite safe in calling it porphyrytic. I have only traced it so far as Indian River, but it appears to extend much farther.

This formation also extends north-west of Halifax ; Pockwock lake being about the most northerly point.

2. (*a*) Cambrian.

This formation includes the gneissoid rocks, quartzites and argillites, it runs close up to the archæan. The gneissoid rocks are the only ones that touch the archæan in this part of the county. It contains *pyrite* in such quantities as to colour the soil in some places where there is a wash from the hills. At this season of the year it forms quite a deposit of iron oxide, so much so as to induce some to search for iron beds north of the gneissoid rocks, the argillites come in and continue much farther north than I have examined ; next to the gneissoid rocks the

argillites appear to be much finer and of a brighter blue than farther away.

North of Wright's lake the strike of the gneissoid strata is north 80° east. At English's corner five or six miles east, the strike is N. 75° E. South-east of Pockwock lake there is a vein of quartz, about four feet and a half wide ; here, some years ago, there was a shaft sunk about one hundred and eighty feet deep, in the hope of finding gold, without success.

By pacing the gneissoid rocks I found that they were a mile and a half wide. On account of the quantity of snow in the woods, which obscured them, I could not find out how much farther they extended.

Along the strike the gneissoid rocks extend from Pockwock lake about seven miles to the eastward. They may continue a long distance either east or west, but on account of the snow it was impossible to follow them.

I found a great many quartz veins which were cross leads ; most of them were over four inches thick.

There is said to be gold in Hammond's Plains, but not in paying quantities. Thousands of dollars have been spent in sinking shafts, and although I took a great deal of trouble to find out what quantity of gold had been taken out, I did not succeed.

On the hill to the south-east of English's corner, I found a small vein of granite where they had been prospecting for gold ; it contains a great quantity of *mica of a gold colour* in curiously wrinkled masses ; it also contains *black tourmaline.*

The gneissoid strata are all vertical and very regular ; breaks being very scarce.

The essential minerals which I found in the gneissoid strata are quartz, sometimes there is a little mica and feldspar.

The accidental minerals which I discovered were black tourmaline, pyrite and andalusite.

(*b*). Cambrian.

Argillites.—The argillites come in about a quarter of a mile above the road to Hammond's Plains and near the gneissoid strata. They are finer and of a brighter blue than they appear farther

north; as already noticed the argillites do not contain nearly as much *pyrite* as the gneissoid strata. The argillites continue a long distance north, but are covered by the Pleistocene formation. Their dip is vertical. There appears to be more crystals of quartz in the veins of this part of the Cambrian than in the gneissoid strata, but perhaps this may not be the general rule but only the case in this locality.

(c). CAMBRIAN.

Quartzites.—The quartzites occupy a large part of the district. The Pleistocene does not cover them as it does the argillites and gneissoid rocks. The dip of the quartzites is about from 18° 22°. The strike differs a great deal, varying from N. 15° E. to N. and S. magnetic. They appear to have been much more disturbed than either the gneissoid rocks or argillites. Faults appear to be very frequent.

PLEISTOCENE.

This formation overlies the Archæan in some places and covers a great part of the Cambrian. It consists largely of granite, syenite, porphyrite, diorite, dolerite and quartzite, amygdaloid, schist, chert and conglomerate boulders.

At Pulsifer's some years ago was found a beautiful hematite, which Dr. Honeyman said had come from the Londonderry Mines, and it has been satisfactorily proved that he was correct, both by the striation and by the boulders accompanying it, which were diorites, syenites and amygdaloids, especially the diorites, which were very hornblendic and contained oligoclase (soda feldspar). One specimen which I found is very beautiful and contained a little mica and pyrite. These, without doubt, came from the Cobequid Mountains.

The specimen of brown hematite has exactly the same streak as the Londonderry iron, and cannot be distinguished from it by any test. The specimen is a very fine one, weighing five pounds and a quarter. It is beautifully crystalized. The structure is mammillary, very compact.

At Indian River, St. Margaret's Bay, I found great quantities of granite which very much resemble syenite. At North-East

River there was a great scarcity of them. All have red feldspar. Overlying the Archæan are great quantities of porphyritic granite boulders, rather darker than the Archæan granite *in situ*.

The amygdaloids have been found westward as far as the School House lake, but not found farther.

Pleistocene.

Striation.—The striation occurs in the gneissoid strata at Pockwock lake. It runs north and south, and N. 35 ° E. It also occurs in the gneissoid strata on the Margaret's Bay road, running north and south and S. 10 ° W. I found it also on the argillites on the Hammond's Plains and Sackville road, running S. 20 E., also on the old Windsor road S. 18 E.; also at Sandy lake, on the Hammond's Plains road, and on the shore south of Bedford, north and south and south and north 10 east. The S. 20 E. line produced north-west passes Blomidon, and cuts a little to the eastward of Cape Sharp, where trap rocks and amygdaloids are *in situ* (Partridge Island and Parrsboro'). The S. 10 ° W. striation produced north-east meets the Wellington station S. 25 W. striation at the Gore. The latter striation produced northerly passes through the Londonderry iron deposits, and the archæan diorites, syenites, etc., of the Cobequids.

APPENDIX.

Intestinal Canal of the Moose.

Not being able to find in any work accessible to me the length of the Intestinal Canal of the Moose (Cervus alces); the following note may be worth recording.

On the 8th November, 1880, I measured the intestinal canal of a full grown cow Moose which had been just killed and found it to be 211 feet 2 inches in length. The cœcum was 2 feet long and about 3½ inches in diameter, its outlet narrow, below it the intestine for 14 inches was quite large, but the succeeding 60 ft. was of the normal size; the "fat gut" or that part of the intestine where the fœces are separated into pellets, at this season, of the year, to the anus measured 10 feet 6 inches.

The length of the intestinal canal of a full grown ox is usually given as about 150 feet.

R. Morrow.

Notes on some Palæozoic Bivalved Entomostraca. By Prof. T. Rupert Jones, F.R.S., F.G.S.

Beyrichia tuberculata (Kloeden).

Length, 1·7 and 1·6 inch.

In his papers on the Geology of Arisaig, Nova Scotia, read before the Geol. Soc. Lond. in 1864 and 1870, the Rev. Prof. D. Honeyman, D.C.L., referred to some Upper-Silurian Entomostraca from that district. At p. 344, Q.J.G.S. vol. xx. they were quoted as *Beyrichia pustulosa*, Hall; *B. equilatera*, Hall; *Beyrichia* 2 spp., and *Leperditia sinuata*, Hall. Some specimens from Arisaig left with me by my friend Dr. Honeyman in 1862 for examination were described in the Q. J. G. S. vol. xxvi. p. 492, as being *Beyrichia tuberculata* (Kloeden); *B. Wilckensiana*, Jones; *B. Maccoyiana*, Jones; and *Primitia concinna* (?), Jones. There are

also other *Primitia* associated with the foregoing. One resembles *P. ovata,* J. and H. They occur more or less abundantly in a highly fossiliferous dark-grey limestone.

Fig. 8 is an inside cast of a right valve, devoid of the test ; the main lode and the postero-dorsal angle are broken. Fig. 9 shows a perfect left valve ; and Fig. 10, a fine right valve, still partly imbedded in the matrix along the dorsal edge. In the latter the anterior lobe is not divided into two as it usually is.

Probably these specimens may be the same as the form described by Prof. James Hall and Principal Dawson as *B. pustulosa,* Hall (" Canadian Nat. and Geol." vol. v. p. 158, fig. 19, woodcut ; and " Acadian Geol." 2nd edition, p. 608, fig. 216, woodcut ; but I find no essential difference between the very fine large specimens before me and the Scandinavian specimens of *B. tuberculata* described and figured in the " Ann. N. Hist." ser. 2, vol. xvi. p. 86, pl. 5, figs. 4–9.

GENERAL METEOROLOGICAL REGISTER FOR 1880.

HALIFAX, NOVA SCOTIA.

Latitude 44° 38′ 25″ N. Longitude 63° 34′ 0″ W. Height above Sea Level 118.2 feet. Calculated from Tri-hourly Observations.

BY AUGUSTUS ALLISON.

1880.	January.	February.	March.	April.	May.	June.	July.	August.	Sept'r.	October.	Nov'r.	Dec'r.	Year. 1880.
Mean Temperature	27.15	25.28	24.18	37.18	47.89	57.79	64.83	63.00	59.77	48.65	34.12	26.27	43.01
Maximum Temperature	47.0	48.8	45.4	61.8	88.0	86.3	83.4	90.0	85.0	70.0	60.4	45.0	90.0
Minimum Temperature	3.4	−3.4	0.0	18.0	29.2	40.1	49.0	44.3	38.0	31.2	11.7	7.0	−3.4
Monthly and Annual Ranges	43.6	52.2	45.4	43.8	58.8	46.2	34.4	45.7	47.0	38.8	48.7	38.0	93.4
Mean Maximum Temperature	35.95	33.95	31.91	46.17	57.85	68.88	74.78	74.16	69.06	57.38	41.22	31.79	51.93
Mean Minimum Temperature	17.30	17.16	16.12	28.71	38.65	47.72	56.57	53.74	51.38	39.84	27.38	20.39	34.58
Highest Daily Mean Temperature	41.17	39.87	38.00	48.56	66.60	69.35	71.72	74.65	71.30	63.54	54.80	39.16	74.65
Lowest Daily Mean Temperature	8.34	2.54	10.97	25.46	38.96	48.92	61.20	54.64	49.00	36.79	18.50	12.37	2.54
Mean Daily Range of Temperature	18.65	16.79	15.77	17.46	19.20	21.16	18.21	20.42	17.68	17.54	13.84	11.40	17.34
Greatest Daily Range of Temperature	34.0	31.0	23.3	28.8	44.7	35.6	28.3	34.7	32.0	31.7	29.2	26.5	44.7
Mean Whole Pressure Corrected	30.120	29.995	29.928	29.949	30.019	29.929	29.947	30.025	30.011	30.059	30.127	29.836	29.995
Maximum Whole Pressure	30.775	30.590	30.530	30.467	30.344	30.287	30.199	30.377	30.326	30.447	30.641	30.472	30.775
Minimum Whole Pressure	29.374	29.177	29.153	29.275	29.191	29.373	29.624	29.672	29.694	29.396	29.349	28.917	28.917
Monthly and Annual Ranges	1.401	1.413	1.377	1.192	1.153	0.914	0.575	0.705	0.632	1.051	1.292	1.555	1.858
Highest Daily Mean Whole Pressure	30.588	30.532	30.483	30.418	30.321	30.244	30.178	30.326	30.276	30.430	30.614	30.399	30.614
Lowest Daily Mean Whole Pressure	29.552	29.518	29.303	29.484	29.596	29.438	29.684	29.758	29.769	29.629	29.731	29.466	29.303
Mean Pressure of Vapour	.141	.124	.114	.173	.274	.371	.504	.479	.435	.300	.177	.132	.26[illegible]
Mean Relative Humidity	89.25	89.00	83.21	77.26	80.29	77.57	82.76	82.51	83.22	84.33	82.82	87.85	8[illegible]4
Mean Amount of Cloud	5.44	5.89	5.69	5.20	6.34	5.75	6.50	4.89	5.32	4.67	4.80	6.86	5.61
Prevalent Direction of Wind	N W	W	N W	W	S E	N	S W	S W	W	W	W	W N W	W
Mean Velocity of Wind	7.80	8.40	8.89	8.25	6.99	5.96	5.40	5.00	6.08	6.28	7.45	8.76	7.10
Amount of Rain	5.393	3.242	1.015	4.097	4.088	1.343	3.086	3.920	5.712	4.590	4.344	3.213	44.043
Number of Days Rain	16	10	3	12	16	12	20	13	15	11	10	10	148
Amount of Snow	23.4	18.8	23.5	7.0	0	0	0	0	0	0	3.6	11.8	88.1
Number of Days Snow	11	15	17	5	0	0	0	0	0	0	7	14	69
Total Precipitation	7.738	5.122	3.365	4.797	4.088	1.343	3.086	3.920	5.712	4.590	4.710	4.403	52.874
Number of Dry Days	11	10	13	15	15	18	11	18	15	20	17	12	175
Number of Auroras	0	0	1	2	0	0	0	0	0	1	1	0	5
" Gales	0	2	1	0	0	0	0	0	1	2	0	1	7
" Fogs	8	5	3	3	10	6	8	9	4	5	3	4	68
" Dews	0	0	0	0	0	4	6	10	10	16	2	0	48
" Hoar Frosts	0	0	2	3	0	0	0	0	0	2	7	2	18
" Thunders	1	0	0	0	5	2	1	1	0	0	0	0	10
" Lightnings	1	0	0	0	6	1	1	3	0	0	0	0	11
" Hails	0	1	0	1	0	0	0	0	0	0	0	0	2
" Rainbows	0	0	0	0	0	1	2	2	1	0	0	0	6
" Lunar Halos	0	0	3	0	0	0	0	0	0	0	1	1	5
" Coronæ	1	1	1	0	0	0	0	0	0	0	0	0	3
" Solar Halos	0	0	0	0	0	0	0	0	0	0	0	0	0
" Days Sleighing	31	25	9	0	0	0	0	0	0	0	0	7	72

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PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART 4.

Provincial Museum, Oct. 12, 1881.

ANNIVERSARY MEETING.

JOHN SOMERS, M. D., *President in the Chair.*

The following were elected Officers :—

COUNCIL.

President—JOHN SOMERS, M. D., F. R. M. S.

Vice-Presidents—ROBERT MORROW, Esq., AUGUSTUS ALLISON, Esq.

Treasurer—W. C. SILVER.

Secretaries—REV. D. HONEYMAN, D.C.L.,F.S.A.,F.R.S.C., and ALEX. MCKAY.

Council—J. BERNARD GILPIN, M. D., M. R. C. S. L., WM. GOSSIP, Hon. L. G. POWER, J. M. JONES, F. L. S., W. S. STIRLING, MARTIN MURPHY, C. E., J. R. DEWOLFE. M.D., L. R. C. S. E., EDWIN GILPIN, M. A., F. G. S., F. R. S.C.

ORDINARY MEETING, Provincial Museum, Nov. 14, 1881.

The PRESIDENT *in the Chair.*

Dr. HONEYMAN read a Paper "on the Superficial Geology of Halifax City and County, &c." The Paper was illustrated by a map.

ORDINARY MEETING, Stairs' Building, Dec. 12, 1881.

The PRESIDENT *in the Chair.*

It was announced by the Secretary that the Council had elected Mr. ALFRED A HARE as member, and Mr. F. H. GISBORNE an Associate member.

Dr. SOMERS read a Paper "On Fungi of Nova Scotia."—Dried specimens of the various species described were exhibited and examined.

ORDINARY MEETING, Provincial Museum, Jan. 9, 1882.

The PRESIDENT *in the Chair.*

It was announced that Mr. J. D. BURBIDGE had been elected a member by the Council.

Dr. HONEYMAN read a Paper "Geological Notes—Metalliferous Sands." He also read "Geological Notes"—By Simon D. McDonald, F. G. S., on Cape Rosier, and Sable Island.

Dr. SOMERS, exhibited the Heart of a Moose, and explained its Anatomy.

ORDINARY MEETING, Provincial Museum, Feb. 13, 1882.

The PRESIDENT *in the Chair.*

Mr. ROBERT MORROW, V. P., read a paper "On the Osteology of the *Lophius Piscatorius.*" The Paper was illustrated by beautifully prepared skeletons ofthe *Lophius*, and of a Codfish head, and by duplicate sints of bones.

ORDINARY MEETING, Provincial Museum, March 13, 1882.

The PRESIDENT *in the Chair.*

Mr. WM. B. MCKENZIE was reported as having been elected an Associate member by the Council.

MARTIN MURPHY, C. E., read a paper "On the Teredo navalis, and the means adopted in other countries for preventing its attacks on submerged timber." The Paper was illustrated by a large collection of specimens.

ORDINARY MEETING, Provincial Museum, April 10, 1882.

The PRESIDENT *in the Chair.*

The Secretary intimated that the Council had elected as members E. W. Plunkett, C. E., Wm. Gossip, C. E., E. H. Keating, C. E., W. Harrington, M. D.

Dr. GILPIN read a Paper "On the Shore Birds of Nova Scotia." The paper was illustrated by specimens from the Provincial Museum collections, and drawings by the author.

ORDINARY MEETING, May 8, 1882.

The PRESIDENT *in the Chair.*

The following were proposed as members :—Mr. John Douglas, and Mr. John James Fox.

EDWIN GILPIN, F. G. S., *Inspector of Mines*, read a Paper "On the Cumberland Coal Field." The paper was illustrated by a sketch map.

ROBT. MORROW, V. P., read the second part of his paper "On the Osteolgy of the Lophius Piscatorius."

The President read a communication from the Rev. E. BALL, Corresponding member, describing a Fern which was considered new to Nova Scotia. The President concluded with remarks upon the Society's Proceedings.

LIST OF MEMBERS.

Date of Admission.

1873. Jan. 11—Akins, T. B., D. C. L.

69. Feb. 15—Allison, Augustus, *Vice-President*, *Meteorologist*, Halifax.

77. Dec. 19—Bayne, Herbert E., PH. D., *Professor of Chemistry*, *Royal Military College*, Kingston.

64. April 3—Bell, Joseph, *High Sheriff*, Halifax.

" Nov. 7—Brown, C. E., Halifax.

78. Nov. 11—Cockburn, Colonel, R. A.

67. Sep. 10—Cogswell, A. C., D. D. S., Halifax.

72. April 12—Costley, John, *Deputy Provincial Secretary*, Halifax.

73. Jan. 11—Dewar, Andrew, *Architect*.

63. Oct. 26—DeWolfe, Jas. R., M. D., L. R. C. S. E.

73. April 11—Gilpin, Edwin, F. G. S., F. R. S. C., *Government Inspector of Mines*, Halifax.

60. Jan. 5—Gilpin, J. Bernard, M. D., M. R. C. S. L., Halifax.

63. Feb. 5—Gossip, William, Halifax.

82. April 10—Gossip, Wm., Junr., C. E., Halifax.

81. Dec. 12—Hare, Alfred, D. C. L., Bedford.

82. April 10—Harrington, Wm., M. D., Halifax.

63. June 17—Hill, Hon. P. C., D. C. L., *Barrister-at-Law*, Halifax.

66. Dec. 3—Honeyman, Rev. D., D. C. L., F. S. A., F. R. S. C., *Secretary*, *Curator Provincial Museum*, *&c.*, Halifax.

74. Dec. 10—Jack, Peter, *Cashier People's Bank*, Halifax.

79. Jan. 11—James, Alex., *Judge of Supreme Court*, Halifax.

63. Jan. 5—Jones, J. M., F. L. S., F. R. S. C., Halifax.

82. April 10—Keating, E. H., C. E., *City Engineer*, Halifax.

64. March 7—Lawson, George, PH. D., LL. D., F. C. I., F. R. S. C., *Professor of Chemistry and Mineralogy*, *Dalhousie College.*

81. Mrch 14—Macdonald, Simon D., F. G. S., Halifax.

75. Jan. 11—Mellish, John T., A. M., Halifax.

72. Feb. 5—McKay, Alexander, *Secretary*, *High School*, Halifax.

77. Jan. 13—Morrow, Geoffrey, Halifax.

72. Feb. 13—Morrow, Robert, *Vice-President*, Halifax.

70. Jan. 10—Murphy, Martin, C. E., *Provincial Engineer*, Halifax.

65. Aug. 29—Nova Scotia, the Rt. Rev. Hibbert Binney, *Lord Bishop of*

82. April 10—Plunkett, E. W., C. E., Halifax.

79. Nov. 11—Poole, H. S., ASSOC. R. S. M., F. G. S., *Sup't. Acadia Mines*, Pictou.

76. Jan. 20—Power, Hon. L. G., *Senator*.

71. Nov. 19—Reid, A. P., M. D., *Sup't. Prov. Asylum for Insane*, Dartmouth.
65. Jan. 8—Rutherford, John, M. E., *Sup't. of Albion Mines*, Pictou.
64. May 7—Silver, W. C., *Treasurer*, Halifax.
75. Jan. 11—Somers, John, M. D., F. R. M. S., *President*, *Professor of Physiology and Zoology*, *Halifax Medical College.*
79. Feb. 10—Twining, Chas. F., C. E., Halifax.
66. Mar. 18—Young, Hon. Sir Wm., KNT., *late Chief Justice of Nova Scotia.*
77. Jan. 13—MacGregor, J. G., D. SC., F. R. S. E., F. R. S. C., *Prof. of Physics*, *Dalhousie College*, Halifax.

ASSOCIATE MEMBERS.

63. Oct. 6—Ambrose, Rev. John, A. M., *Rector of Digby.*
77. May 14—Burwash, Rev. J., A. M.
81. Dec. 12—Gisborne, F. N., Ottawa.
78. Feb. 11—Louis, Henry, Assoc. R. S. M., London.
71. Jan. 11—McKay, A. H., B. A., B. SC., *Principal of Pictou Academy.*
75. Nov. 9—Kennedy, Prof., Wolfville.
61. Dec. 8—Morton, Rev. John, *Missionary of the Presbyterian Church of Canada*, Trinidad.
76. Mar. 12—Patterson, Rev. George, D. D., New Glasgow.
81. Mar. 14—Stearns, T. G., (of New York), Middleton, N. S.
80. May 10—Walker, Jas., M. D., St. John, N. B.

CORRESPONDING MEMBERS.

71. Nov. 29—Ball, Rev. E., Maccan.
68. Nov. 25—Bethune, Rev. J. S., Ontario.
70. Oct. 17—Harvey, Rev. Moses, St. John's, Newfoundland.
71. Oct. 12—Marcou, Jules, Cambridge, Mass, U. S.
80. June 10—McClintock, Sir Leopold, KNT., F. R. S., &c., *Vice-Admiral.*
77. May 14—Weston, Thomas C., Geological Survey of Canada.

LIFE MEMBER.

Parker, Hon. Dr., M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—NOVA SCOTIA GEOLOGY (SUPERFICIAL.) *Continued from Transactions 1875–6.* BY REV. D. HONEYMAN, D. C. L., F. S. A., F. R. S. C., *Curator of the Provincial Museum.*

(Read Nov. 1881.)

PART I. — HALIFAX COUNTY.

IN H. M. Dockyard, opposite the North street Station of the Intercolonial Railway, is an elevation known as "Observatory Hill." The removal of a considerable part of this during the past summer in filling up an extensive and deep pond, afforded an admirable opportunity of examining its interior. Its proximity to my residence enabled me to note the progress of operations. The superintendent, Mr. Nolan, kindly took note of every massive boulder exposed, observing its position and size. "*Rudis indigestaque*" is its general description; structure, it had none. It was just an unloaded heap of rubbish. Its chief materials were coarse sand and clay. Through this masses of quartzite were scattered from top to bottom. The weight of one was estimated by Mr. Nolan at 13 tons. I was present at one fall in which there were three enormous boulders. One of them fell upon the car-track; nine men were required to remove it. Among the other boulders were syenites, gneisses, granites, diorites, jaspers, porphyries and diorite-amygdaloids from the Cobequid Mountains, and dolerite-amygdaloids from Blomidon. The form of this accumulation was oblong; its base occupied an area of 18 acres; its height was about 50 feet, more than the half of it still remains.

Glaciation was observed on the side of Water street, near the Dockyard, before the I. C. R. was extended to North street. Opposite the Sugar Refinery and on the same street, striation was observed last summer. The course of this was, N. 30 W., S. 30 E., mag.; N. 48 W., S. 48 E., true. This is in the direction of Blomidon and Observatory Hill. In my first paper I pointed out another course of glaciation at Wellington Station, on the I. C. R., made by the transportation of the Cobequid Mountain contingent on its way to unite with that of Blomidon for the formation of Observatory Hill and corresponding accumulations. The direction of Wellington Station glaciation is nearly N. and S. true. The Cobequid Mountain boulders have travelled overland from 65 to 70 miles; the Blomidon 60 miles. The massive quartzite boulders have travelled between ½ a mile and 8 miles.

Fort Needham.

The elevation so-called has a constitution similar to that of Observatory Hill. This, too, has Archæan syenite boulders, as well as Triassic amygdaloid. I collected specimens of these in exposures not far from the glaciation opposite the Sugar Refinery. In passing to the west side I ascended the hill. On the top I observed quartzite boulders of dimensions not inferior to those of Observatory Hill. In the western exposures on Gottingen street I collected Archæan syenites and diorites, and Triassic amygdaloids.

On the same street, opposite the Wellington Barracks, exposed glaciation is extensive. The general direction corresponds with that of Water street, S. 48 E., N. 48 W.

Citadel Hill

furnished Archæan and Triassic boulders. On the east side there is glaciation having the same direction as the preceding. The glaciation of Point Pleasant Park is generally S. 38 E., N. 38 W.

Eastern Extension.

Accompanied by Mr. Bell, High Sheriff of Halifax, I proceeded last summer to extend my acquaintance with the geology of the eastern part of Halifax County. I now give the results of my examination of the Superficial Geology.

PART II.

Waverley Gold Mines.

Coming to Dartmouth we proceeded on the road to Waverley. A short distance from the road to Preston drift was observed having a few Archæan Syenites without Triassic amygdaloids. In my former paper I noticed the occurrence of the latter on the Preston road. No more drift was seen until we reached the Waverley Mines. In an exposure of drift at the back of the stables I had collected Triassic amygdaloids on a former examination. Here they were collected a second time—two specimens. We proceeded farther and reached what is called the Old Guysboro' Road. This road runs easterly and crosses the direction of transportation. I consequently expected interesting revelations in this route. Drift was first observed near Rutherford's Mill, about four miles along the road. In it were syenite boulders. At Sullivan's (see Map of Halifax County) glaciation was seen and examined. The rock is argillite; the course of the striation is N. S. mag. (N. 18 W., S. 18 E. true). At Goff's archæan boulders, syenite and diorites are numerous. The sinking of a well showed considerable thickness of red clay. A beautiful specimen of Triassic amygdaloid with amygdals of radiating stilbite was found about a mile beyond this, which was evidently a rare one thus far east. Cuttings and other exposures of drift continued as far as Meagher's Grant. In these I found syenitic and dioritic boulders, with other amygdaloids (dioritic, with calcite amygdals) similar to those found in Observatory Hill. In Meagher's Grant, on the road to Musquodoboit Harbour, at an outcrop of lower carboniferous limestone, I observed drift with boulders of syenite and diorite. We then lost sight of the drift, our course being over solid granite. About a mile before we reached the harbour, we left the granite and entered upon argillites. These are largely obscured by the granite transportation, which has evidently taken the place of the syenite, which seems to have been intercepted by the granite belt over which we have passed. At the Harbour, on its west side, I found a few small boulders of syenite and diorite. It required close observation to find these among

the abounding granite boulders. I suppose they may have reached this point by travelling along the course of the Musquodoboit River.

Jeddore.

We observed only granite transportation until we came to Jeddore. Then road cuttings gave promise of something different; but as we intended to go as far as Clam Harbour, we left the examination of this drift until our return. Approaching our destination we observed on the road a considerable outcrop of quartzite with glaciation. At the entrance of the Clam Harbour road, a large outcrop of argillite, which is beautifully glaciated, was passed, and we came soon to our terminus.

Clam Harbour.

Looking around this locality, I observed some exposures of the familiar drift of the usual reddish colour, and found syenitic and dioritic boulders. This led me to expect other exposures on the shore. We made for Clam Bay. The impression made by the first view of this Bay will not readily be effaced. It has a sweep of about 11 miles, as far as Jeddore Head, and is washed by the broad Atlantic. It was ebb-tide, showing the greatest extent of its wide beach and white sands. On the bank was observed an exposure of red drift. In this I collected syenites, diorites, &c. From this point, the similarity of the several drift banks extending to Jeddore Head was readily recognizable. Not having an opportunity to examine these, I resolved upon doing what was next best,—upon examining carefully the exposures already referred to as occurring upon the road, regarding these, as corresponding with the lofty banks on the side of the bay. Connected with our drift bank, and partially overlying it, a marine formation is in progress, washed and heaped up by the Atlantic waves and storms. This sand is beautifully white, being chiefly formed of the siliceous and micaceous *detritus* of the transported granite.

In this formation we have—

1 Ripple marking.
2 Rill marking.
3 Worm tracks.

4 Worm burrows.
5 Bird tracks. *Tringa minuta.*
6 Imbedded egg cases of Raia. *(Pisces.)*
7 *Mollusca. Natica heros.*
8 *Mactra solidissima.*
9 *Mya arenaria.*
10 *Saxicava (?)*
Crustacea.
11 Crabs.
12 Shrimps.
13 *Echinoidea. Echinus. Echinarachnius, &c.*

We have thus the "Recent" (Cené) lying directly on Post-pliocene drift. The succession is seemingly irregular. The arrangement corresponds, however, with that occurring at the other parts of the bay, and other drift accumulations on the shore, on to Thrum Cap, at the mouth of Halifax harbour. The clays andsands of the Champlain period appear to be wanting. That either these or their equivalents are absent, we have no reason to suppose. That the Red Heads and other drift banks of the shore are the extremities of the drift transportation, I do not believe. I rather believe that it may have extended to a considerable distance, and that it has been denuded to a great extent since the Glacial period, by the ceaseless action of the Atlantic. On this supposition the Pleistocene drift *may* now underlie the Banks, and be overlaid by Champlain clays and sands, with overlying clays and sands of the present period. Returning I examined the two glacial exposures already referred to. The courses of the two are parallel, being S. 10 W., N. 10 E. mag., or N. 8 W., S. 8 E., true.

The drift cuttings on the road side at Jeddore yielded, as was expected, boulders of syenite and diorite, also a beautiful diorite amygdaloid boulder, having sub-spherical amygdals of reddish quartz (chalcedonic). Between Jeddore and Musquodoboit Harbour no drift cuttings of this kind were observed. At the latter place syenite and diorite boulders were again collected.

About a mile farther, at Petpiswick, extensive outcrops of

strata were observed. These are much glaciated. The very ferruginous character of the argillites affected the compass so much that I was unable to take the course of the striation. The accompanying drift cuttings on the road side showed the usual syenite and diorite boulders. In a cutting of drift at the Chezzetcook road, I found similar boulders and a large agate.

Porter's Lake.

Between this and Chezzetcook I expected most certainly to find drift corresponding with that of Three Fathom Harbour point and Half-Island, where I found Triassic amygdaloids on my first examination. (Paper 1875-6.) I found neither amygdaloid drift nor glaciation. About a mile beyond Porter's Lake we found very distinct glaciation, and of considerable width, without any appearance of drift. The course of the former is N. E. magnetic; S. 18 E., N. 18 W., true. The transportation is granite. One immense boulder near a glaciated surface, attracted particular attention. It had interfered with the growth of a tree of considerable size. By it the trunk of the tree was indented half way. Proceeding, we arrived at Big Salmon River. At the beginning of Preston, drift was well exposed in the bed of a brook on the right side of the road. I here found a Triassic amygdaloid boulder of considerable size. The granite transportation ended before we reached Salmon River. I had thus certain evidence that this belt of granite which had not heretofore had a place in our geological maps, extended in width from Meagher's Grant to Musquodoboit Harbour, less one mile,—i.e., about 6 miles in length, from Ship Harbour, next Clam Harbour, to Lake Major, near the Waverley Gold Mines, 28 miles. We have now reached ground described in the previous Paper.

Part III.

Resuming our investigations, Mr. Bell and I proceeded directly to Meagher's Grant. From this we took the road to Little River Settlement; course N. E. Syenite boulders were observed along the road and in the settlement. From this we proceeded to Middle Musquodoboit; course N. E. Syenite boulders were observed all the way. They abound at the bridge

which crosses the Musquodoboit River. From Middle Musquodoboit we proceeded to Upper Musquodoboit; course, E. Deep cuttings of drift and vast numbers of syenite boulders, large and small, were observed. Reaching the road leading to the Cariboo Gold Mine, we turned in the direction of the mine; S. On the South side of the Musquodoboit River we returned to Middle Musquodoboit, observing syenite boulders all the way through, but not in so great a number as we observed on the north side, by which we went.

From Middle Musquodoboit we went to Gay's River; course, N. W. On this road we found the drift banks very numerous. and very deep cuttings, showing abundance of syenite boulders; great and small boulders of dioritic amygdaloids were also found with amygdals of calcite. At Gay's River we advanced into Colchester County as far as the "Gay's River Gold Field." On this road syenitic boulders were also observed. Returning by the same road to Halifax County, we proceeded to Elmsdale by the old road; S. W. Drift, with syenitic boulders, was observed all the way. A short distance beyond the road to Milford, syenitic boulders were particularly noticed beside a "roche moutonnee" very singularly rutted. Here the Cobequid Mountains, the source of the syenitic boulders, were seen in the distance, without any intervening elevations.

From Elmsdale we returned to Dartmouth and Halifax city. Between Elmsdale and Waverley we missed the familiar drift, with syenitic boulders. Instead of these we had another granite transportation from the belt of granite which is seen from the Intercolonial Railway, on the east side of Fletcher's Lake, as we pass by Railway from "Windsor Junction" to the "Wellington Station." We now come to the end of the old Guysboro' road, which we have already travelled twice.

PART IV.—COLCHESTER COUNTY.

I resumed my investigation in this County, accompanied by the Hon. Samuel Creelman, Chief Commissioner of Mines of Nova Scotia. We proceeded by railway to the Brookfield Station. This station is distant from Three Fathom Harbour 43 miles; from

the Cobequid mountains, 17 miles. Here syenitic boulders are found in abundance. From this we went to the Brookfield iron (hematite) deposit; thence to the lead mines of Smithfield and Pembroke, and then to the "Cross Roads" of Upper Stewiacke and "Round Bank," Mr. C.'s residence, our course being generally easterly. In all this tortuous route syenitic boulders were seen in abundance. Like Mr. Bell, Mr. Creelman had become greatly interested in my investigations, and he now regards the boulders of life-long acquaintance in a new and interesting light. The "Cross Roads" just referred to are noted on our maps. The striation of Clam Harbour extending northerly passes through this point, and cuts the Cobequid mountains in the vicinity of "Mount Thom," Pictou County, where the Archæan belt seems to terminate. I consequently expected the syenite and associate boulders to diminish in number and gradually disappear to the east of the "Cross Roads." Standing in front of Mr. C.'s residence we see Berry-hill on the south side of the Stewiacke River. On either side of it there is a depression. The Clam Bay line of transit would seem to run along the left depression, while the Jeddore would traverse the other. We went to the top of this hill (S.). On the table land are several extensive farms. The Archæan boulders which abound below seem to have almost disappeared. After a diligent search among stone cairns collected out of the cultivated fields, I found only half-a-dozen diorites. We traversed a summit road to some distance westward, toward the Jeddore line, without observing the looked for boulders. Descending northwest on the side of this depression, we came to the line of boulder passage (Jeddore line), and reached the region of abounding boulders. Afterwards I investigated the region to the N. E. of the "Cross Roads." Contrary to expectation, I found Archæan boulders in abundance, as I went along the course of the Stewiacke River, toward the Pictou and Colchester County line. In the river the abundance of boulders, both large and small, was particularly observed as well as their variety and beauty. I advanced to within two miles of the County line, and found large boulders still occurring. I left off the search for their termination at this time.

We afterward proceeded to "Riversdale station," of the Pictou railway, i. e., in a northerly direction, toward "Mount Thom." Archæan boulders were seen in abundance occurring along the road, except where the mud and mire were too deep for any stone to raise its head. They were seen at the station, and on the north of Salmon River, in sufficient abundance and magnitude, and at no great distance from the mountain. We were now 47 miles N. of Clam Bay, and 3 miles S. of Mount Thom. From Riversdale we returned by railway to Halifax.

Part V.—Pictou County.

I returned to Riversdale station and thence proceeded onward. On both sides of the line of railway, Archæan boulders were observed. I stopped at West River station for the purpose of examination. Here boulders abound. Those in front of the station are occasionally of large size, most of them are syenite, one is granite, being composed of quartz, muscovite and orthoclase and resembling the granites of Halifax. It is much different from the other granites which I have found in the Cobequids, although it is unquestionably derived from rocks of the same series. I then walked along the road which leads to settlement S. E. of the station. The usual boulders were observed all the way,—1½ miles. I collected at the end of the road, syenites, diorites and dioritic amygdaloid. Further examination in this direction is deferred to another season. Returning to Halifax I stopped at Milford station for the purpose of examining the *roche moutonnee*, referred to in Part III. Starting from Milford in search of this rock, I had some difficulty in finding it, so that I travelled about thirty miles before I succeeded in my search. These wanderings, however, were of service, as they showed me Archæan boulders in all directions, and the want of triassic boulders where I expected to find them. On the *roche* in question I observed five well-defined parallel lines having a course S. to E. N. 10 W. Besides these are parallel *ruts*, having a course S. 40 E., N. 40 W. Two of these were bent and turned in a direction S. 30 E. The character of this rock, quartzite, its position 13 miles east of the Halifax meridian, north side of the band of

metamorphic rocks, in sight of the Cobequid mountains, and its very distinct glaciation, led me to regard it as a very interesting object. In my paper of 1875-6, I quoted an observation from a table in "Acadian Geology," a position at the Gore having striation with a course S. 20 E. I had resolved to search for this striation. This *roche* saves me the trouble, and seems to furnish a sufficient reason, in connection with other observations, to which I shall yet refer in a future paper, for the distribution of boulders to the east of Clam Harbour line. It also gives occasion to modify certain conclusions at which I had arrived in my first *Paper*. Coming from the N. E., I searched as far as Elmsdale for boulders and minerals from the Triassic eruptive rocks, which extend as far east as Five Islands, without finding any. In my *Paper of 1875-6*, I stated that I had found specimens in the clays of Enfield. Last summer I found a specimen as I was approaching the top of Grand Lake from the Enfield station. Enfield, therefore, seems to be the limit of their distribution in this direction. The other extreme points seem to be half-a-mile beyond Gore. On the old Guysboro' road, the east end of Preston and the west point of Five Fathom Harbor. These two seem to be a sort of outliers, while extreme points of the main triassic amygdaloid transportations are Fletcher's station on the Intercolonial, Navy Island, on the east side of Bedford Basin, Dartmouth Cove and Laurencetown, at Half-Island.

GRAND LAKE.—(CENE FORMATION.)

While investigating the Pleistocene Geology around Grand Lake, I directed attention to the Lacustrine forms which I believed, in common with others, to be "Prehistoric Pottery." (Proceedings 1879-80.) I examined these *in situ*, and secured several specimens. I was therefore led to entertain some doubts in regard to their artificial formation. A chemical examination showed me that the supposed plastic portion of the article was *Hydrous iron sesquioxide*, and that the supposed pottery was "Lacustrine hematite concretions," We have therefore in Grand Lake a new formation in progress of a singular construction.

Rocking Stone.

Roche Perché.

The Rocking Stone of Spryfield has long been regarded as an object of interest; it is situate about 11 miles north of Pennant Head, and 5 miles west of Sandwich Point, which lies between York Redoubt and Herring Cove. I had long heard of it, but had not seen it until the last Saturday of last October. I was astonished at its imposing appearance. Having reached its top by a ladder, which is placed against it for the convenience of visitors, I enjoyed a strange rock in this wonderful cradle. My conductor and companion, Simon D. Macdonald, F. G. S., seeing me seated on the top, went to the end of a lever, also placed in position, and commenced operations. The mass began to move, the motion increased and the rocking commenced, and was continued until I was satisfied. Mr. Murphy, C. E., Provincial Engineer, informed me that he had measured the boulder and calculated its weight, which is about 200 tons. It must be wonderfully set and balanced. It is placed in the forest, a beautiful little lake is on its west side. The sun setting in the west, the scene was beautiful and romantic. The boulder has a venerable look. It is coated with lichens, so that its lithological character is not at all apparent. This has led to the belief that it is not like the rocks around. My hammer soon satisfied me regarding its true character. It is a mass of coarse, porphyritic granite. Its constituent minerals are glassy-brown quartz, black mica and beautiful white orthoclase. The rock upon which it is poised is of the same character, and so are the other granite boulders in the locality. It may have travelled 9 or 10 miles, or it may not be far removed from its original position. As we walked to and from, I made observations on our way which I shall briefly describe:

Halifax to Dutch Village.

Our starting point is North Street, opposite Railway Station and H. M. Dockyard. Along North Street we proceeded westward. Beyond Agricola Street crossing is an outcrop of argillites, beautifully glaciated. The course of this striation is S. 20

E., N. 20 W., mag.; or S. 38 E., N. 38 W., true. This is 10° different from the course already observed at the Sugar Refinery opposite Wellington Barracks, and at Brunswick street, Citadel Hill. *Part* I. This striation corresponds with that of Pleasant Park, which is generally S. 20 E., mag. *Paper of 1875-6*. Coming to Leahy Villa, we find another glaciated exposure. It is 30 years since I first discovered this. The appearance is not now so striking as it was then. I had heard of Agassiz's glacial theory and glaciation before leaving Scotland. This was the first glaciation that I had seen. Since then it is very much defaced; the glaciation has largely shelled of. I would remark that the position of the argillites is vertical. It would be impossible for me to cut off either with hammer or chisel, a piece of unstriated surface, as the weather has done, or as I could do this if striated. This would seem to indicate that a thin *stratum* had been formed on the ends of the tilted argillites by the pressure of the striating agency. Here the prevailing course is S. 10 E., mag. Feeble and small *striae* diverge from this course; grooves occasionally run to 30° and return to 20°. Faults are very numerous here and elsewhere, varying from 2 to 9 inches. The course is not interrupted by these. The north side ascends and then at a considerable angle, and then it becomes level. Two granite boulders lie on this exposure; of these, the largest is 3½ x 3 x 2 feet. The extent of exposure is 300 x 150 feet. Farther on in the drain on the north side of the road, is another exposure, having a width of 30 feet, and striation course S. 20 E. There are still two others before reaching the Bridge. The striation of one has been shelled off, the other has a steep northern inclination on the surface. Coming to the North West Arm, our course was changed from W. to S. W. Here we observed great sections of drift. The boulders were granite, gneissoid and argillites, syenites and diorites and amygdaloids, dioritic and doleritic were absent. We entered on a road which I had not previously travelled. We were now among granites. Coming into line with Williams's Lake, we suddenly passed into gneissoid rock, and then into granite. I recognized an old acquaintance, and was on familiar grounds, having followed the gneissoid rocks on

this side of the harbour, in all their windings and dovetailings, into the granite, and defined them on the Admiralty Charts of Halifax harbour, years ago. Here the granites are strikingly porphyritic; these are *roches moutonées.* The ruts in these indicate transportation and its direction. The deep ruts only survive; air, ice and water have so affected the material of the rock as to efface fine striation. Coming to a cross road, we turned to the right and at length reached the "Rocking Stone." Not being altogether satisfied, I returned to the N. W. Arm the succeeding Saturday and continued the westerly course beyond the bridge, going along the St. Margaret's Bay road. Rocks outcropping on the right side are gnessoid. I found one beautiful syenitic gneiss boulder on the road. This is the only one that I have seen west of H. M. Dockyard. Drift cuttings are observed without noteworthy boulders. Approaching the Halifax water works the granites which extend south to the Atlantic coast came forward to the road. They are seen in conjunction with the gnessoid rocks. At a distance of four telegraph poles beyond the four mile post, a gnessiod rock is seen on the left side of the road, scooped out, with striation on the side of the scooping. The position of the striation and the ferruginous character of the rock, made it impossible to observe the course accurately with the compass. It seemed to be about S. 20 E., N. 20 W., mag. A large granite boulder rested above. The granite here is not porphyritic as that in the vicinity of the Rocking Stone; the constituent minerals are the same. This is granite transportation No. 3. The amygdaloidal and syenitic transportation, which Mr. Hare reports on the north, seems to have been intercepted. —*Paper by Mr. Hare, Transactions, 1879–80.*

CENE.

In the lake at the Halifax water works, Mr. Keating, the City Engineer, reports the existence of an argillaceous deposit, which is largely composed of diatoms. Its thickness is about 6 feet.

(To be continued.)

ART. II.—NOVA SCOTIAN, FUNGI—J. SOMERS, M.D., F.R.M.S.

(Read Dec. 12, 1881.)

I HAVE been enabled during the past season to make the following additions to our mycological Flora; before proceeding therewith, I wish to record an expression of thanks to Professor Chas. H. Peck, of the State Museum of Natural History, Albany, N. Y., for very great kindness in diagnosticating and naming several species of which I had no description, I trust that students of Botany who are working in this branch will soon have from the pen of the professor a work which in its own department will rival the celebrated Text-book of Dr. Gray.

ORDER—AGARACINI.

1. Agaricus (Mycena) galericulatus. *Scop.* com. Sept. '81.
2. A. (Pluteus) cervinus, *Schœff*, com. Sept. '81.
3. A. (Entoloma) strictor, *P. K.*, W. P., " "
4. A. (Eccilia) carnogriseus, *Br.* " "
5. A. (Leptonia) lampropus, Fr., *in pastures.*
6. A. (Hebeloma) fastibilis, Fr., com. Sept. '81.
7. A. (Galera) Hypnorum, Fr., Oct. '82.
8. A. (Psilocybe) spadiceus, *Scoœff*, Oct. '82.
9. A. (P.) cernuus, Mull, under willow, Oct. '81.
10. Coprinus micaceus, Fr. common.
11. Cortinarius (Inoloma) lilacinus, *Peck*, Willow Park, Sept., Oct. '81.
12. Lactarius torminosis. Fr., Aug. '81.
13. L. quietus, Fr., in woods, Nov. '81.
14. L. Cyathula, Fr., Fir woods, Sept.
15. Russula depallens, Fr., under spruce.
16. Cantharellus, floccosus *Schw* under pine trees, N. W. A., Oct. '81.
17. Lenzites abietina, Fr,, on larch stump.

ORAL II.—POLIPOREI.

18. Polyporus picipes, Fr. Oct. '81.
19. P. chioneus.
20. P. albellus, *Peck*, Willow Park, Oct. '81.

Gen. Dædalea. Fr.

21. Dædalea, quercina, P., on old trunks, Oct. '81.

ORDER, HYDNEI.

Gen. Irpex. Fr.

22. Irpex tulipiferæ, *Schw.* on dead branches, Willow Park, Oct. '81.

ORDER.—AURICULARINI.

Gen. Hymenochœte. Lev.

23. Hymenochæte, tabacina. *Lev.*
Dead branches on the ground, Oct. '81.

ORDER.– CLAVARIEI.

Gen. Clavaria.

24. Clavaria, abietina. *Schum,* under spruce Fir, Sept. '81.
25. C. Pulchra. *Peck.* Beech grove, 3 mile House, Oct. '81.

Fam. Gasteromyectes.

ORDER.—MYXOGASTRES.

Gen. Æthalium.

26. Æthalium, septicum, Fr., on dead willow stumps, Sept. '81.

ORDER.—NIDULARICEI.

Gen. Crucibulum.

27. Crucibulum, vulgare. *Tul.*,
on dead twigs, on the ground, Willow Park, Oct. '81.

Fam. Ascomyectes.

ORDER.—ELEVELLACEI.

Gen. Leotia.

28. Leotia, lubrica. *Pers.*,
on the ground under Birch, 3 mile House, Sept. '81

ORDER.—SPHÆRIACEI.

Gen. Hypomyces.

29. Hypomyces, lactifluorum. *Schw.*
Parasitic, on fungi, Willow Park, Sept. '81.

Gen. Hypoxylon.

30. Hypoxylon, concentricum. Grev.,
on dead Birches 3 mile House woods, Oct. '81.

ARTICLE III.—GEOLOGICAL NOTES. METALLIFEROUS SANDS.

BY THE REV. D. HONEYMAN, D. C. L., F. S. A., F. R. S. C.

(Read January 9, 1882.)

I WOULD direct attention to certain Metalliferous Sands, specimens of which have been added to the collections of the Provincial Museum, and to their affinities.

1.—AURIFEROUS.

This is a specimen from Jegoggin Point. Vide Paper "On the Geology of Digby and Yarmouth Counties." Trans. 1880-81.

In this Paper I directed attention to the *Garnet sand* of Lake George, and its origin. I also noticed Jegoggin Point as a locality where rocks are largely micaceous schists, replete with garnets. These were considered to be a continuation of the Lake George rocks, from which the garnet sands were derived. When I was examining Jegoggin Point, with Mr. S. M. Ryerson, I observed great veins of quartz pervading the garnetiferous schists. Mr. R. informed me that gold had been found in them. I was therefore not at all surprised when I heard that Mr. Cowan had found gold in the sands of Lake George. The fact of the existence of a gold mine at Cranberry Point, adjoining Jegoggin Point, and in the same singular belt of rocks, in a manner prepared me for the report. So when Mr. Cowan showed me his gold washings in the Museum, I was convinced of their genuineness by seeing the garnets associated with the gold. He told me at the same time that his washings were not from Lake George. As the other alternative, I suggested Jegoggin Point. He answered that that was the place. When I examined Jegoggin Point I did not take time to examine its sand, as it was down among the rocks; but I inferred that this, too, would be found to be garnetiferous, as well as the sand at Lake George. This inference is sufficiently obvious. The existence of gold in the sand seems to confirm Mr. Ryerson's statement that gold had been found in the quartz veins. Description of specimen: The most striking part of it are numerous scales of gold; these are associated with beautiful crystals of garnet, having sharp angles; there are also grains of magnetite and

silica. The magnet readily separates the magnetite. There are other black grains which may be hornblende. Hornblende is seen in the schists as well as garnets. The gold and silica may be derived from the quartz vein. Grains of magnetite may exist in the schists in the same way as it occurs in the Archæan gneisses of the Cobequid mountains. Vide Paper "*Archæan Gneisses of the Cobequids Magnetitic.*" Trans. 1880–81. The association of gold with garnets and magnetite in the auriferous "Archæo-Cambro Silurian (lower) of Nova Scotia seems to be of additional interest, as it suggests relationship with distant and foreign auriferous formations where gems and gold with magnetite are seen associated. It certainly has a tendency to correlate the "Nova Scotia Gold Fields" with the "Medicine Bow Range," Wyoming, U. S. This is regarded as having a "strong resemblance" to "characteristic beds" of the "Huronian formation in Canada." "The rock masses which form the Medicine Bow Range have as constituents quartz, orthoclase, plagioclase, hornblende, mica, chlorite and carbonate of lime. As accessory minerals there occur garnet, epidote, magnetite, pyrite, cyanite, *gold* and calcite; under the microscope, in addition to the above, were detected, zircon, apatite and titanite." Descriptive Geology. Medicine Bow Range. By Arnold Hague. Page 109. United States Geological Exploration of the Fortieth Parallel, Clarence King, geologist in charge. Vol. II. Page 109.

We have all the constituent minerals above enumerated as constituents of our rocks, and all the accessory minerals recognized, with the exception of cyanite, zircon and apatite. In the place of these we can substitute staurolite, andalusite, tourmaline, arsenopyrite, calchopyrite and molybdenite. As I use the term Cambrian, as it is understood by H. M. Geological Survey of Great Britain, my nomenclature, Archæo-Cambro-Silurian (lower), will be considered by some as equivalent to Archæan, applied to the Medicine Bow Range, Cambrian and Huronian being regarded as convertible terms. I would observe also that the distinction made by Mr. Hague between his Colorado and Medicine Bow "Archæan," is precisely the same as I make between our great Gold Field series of rocks, and the

Arisaig "Archæan," or the Archæan of Cape Breton, the Cobequid Mountains, &c.

2.—MAGNETITIC.

Through William Ross, Esq., Collector of Customs, Halifax, I have received a specimen of magnetitic sand from Cape Breton. Of 100 grains, the magnet separated 15. The remainder largely consists of garnets and amethyst (?), and possibly titanite; gold is wanting. It is possibly derived from the Archæan crystaltine rocks of Coxheath. The locality where it is found being Ball's Creek. It is said to be in considerable quantity. I have not yet *seen* any garnets in the rocks of this series, either in Nova Scotia or Cape Breton. Magnetite is found. *Paper "Archæan Gneisses of the Cobequid Magnetitic, 1880-1."*

3.—MAGNETITIC.

I am indebted to S. D. Macdonald, F. G. S., for the specimen which I am now to describe. It is from Cape Rosier, P. Q. Its weight is 65 grains. Of this, about 10 grains are taken up by the magnet. The remainder consists chiefly of garnets and amethystine grains. It is very like the Cape Breton specimen. Boulders were collected in the same locality. These are of granitic and syenitic gneisses. In the one garnets are seen, and in the other grains of magnetite. So that the rocks that furnished these boulders, in all probability, are the sources of the sand of our specimen. It is therefore of Archæan (Huronian) origin, like the Cape Breton magnetic sand.

4.—MAGNETITIC.

There is yet another specimen in the Museum collection to which I would refer. It is several years since I received it. It was brought for the purpose of getting my opinion of its value. Its mineral constituents are the same as of the three last described, but it far excels these in the proportion of magnetite. It covers the magnet very readily. I think that this was the reason why I did not receive definite information regarding its locality. If the locality is not in Newfoundland, it is in some part of the Labrador coast. There is a piece of magnetite in the specimen. It is doubtless of Archæan origin.

5.—Magnetitic.

There are also deposits of magnetite sands in Sable Island. Attention was devoted to these long ago. It is more than 20 years since I received specimens. The late Professor Howe included this sand in his collections at the International Exhibition of London, 1862. It corresponds with the sands of Cape Breton, Cape Rosier, and also No. 4, and is different from the auriferous-magnetic sand of Joggin Point. I never saw gold in any specimen. Prof. Howe, in his analysis, found titanium. Any specimens that I have seen are less magnetic than that of Cape Breton. Mr. Macdonald has anew directed my attention to it by presenting to the Museum a specimen of what he collected during a recent visit to the Island.

Sable Island is 95 miles south-east of Cape Canso, and may be underlaid by an extension of the rocks of either Nova Scotia or Cape Breton of any formation. There can be no doubt that its magnetic sands are of Archæan extraction, and in all probability they are *glacially* transp~~arent~~orted, and that from the coast of Labrador, where the Archæan is like that of Cape Rosier, granite and garnetiferous and syenitic and magnetic. The Arctic current, with its ice freight, according to the Admiralty charts, passes along the south side of Sable Island bank, outside of the soundings. This may have been the agency employed in transporting the magnetic sand to Sable Island.

Art. IV. — Geological Notes. By Simon D. Macdonald, F.G.S.

SABLE ISLAND.

(*Read January* 9, 1882.)

Having carefully examined the different points in the vicinity of the main station, where gold was said to have been found, and as yet being disappointed in not finding an opening among the hummocks that I could call an average section, showing the stratification as visible on a small scale in the several indentations along the shore, I turned eastward, feeling assured from the gradual ascending character of the Island in this direction, and its curvature to the north-east, that I should yet find among the hills

sheltered from the prevalent south-west winds, a section that would reveal the internal arrangements of this remarkable formation. Nor was I disappointed, for while plodding along the landwash in company with the south side patrol, at a slight turn in the coast, we came suddenly upon a beautiful escarpment some 80 feet high and reaching inland about 500 feet.

The late southeast gales had undermined the embankment at this place causing a downfall, and thereby had produced a fresh exposure of the sand cliff.

The section of this exposure is as follows:—

1. A strata of dark ferruginous sand........ 2 feet.
2. Dark mottled Ferruginous, Siliceous and Garnetiferous sand..................50 feet.
3. Garnetiferous and Siliceous only........20 "
4. Siliceous sand, light buff colour, with few garnets............................10 "

On comparison with another exposure seen subsequently, I considered this as a typical section of the whole formation of this Island.

Here my friend, the patrol, kindly offered to take me to a place on the south side of the lake where he informed me there was an exposure of jet black sand. Thither we turned our steps when a recall from our steamer somewhat abruptly terminated our expedition in that direction. A sudden shift of wind and a fast rising sea necessitated our presence aboard, and in a few hours we were heading towards the coast in the teeth of a northwester.

CAPE ROSIER.

From Grand Greve to the summit west of Cape Bon Ami the road tends north-eastward across the Gaspe limestones, which are here obscured by drift.

The summit is of grey calcareous shale. From this point the scenery is grand and imposing.

A few feet from the right of the road the precipice is perpendicular about 700 feet. On the left is an escarpment of upwards of 1200 feet, in many places overhanging the tide.

Along the side of the cliff the road descends at an angle of about 45°, in many places cut in the face of the rock.

This formation is grey limestone, in layers of from 6 to 8 inches in thickness, separated by bands of greenish shale, and much shattered. In many places it rises in sharp pinnacles, presenting a grand castellated appearance.

During the spring months the road is abandoned for a more circuitous route by boats around Cape Gaspe, travel being too hazardous from the continual falling of debris along the face of the mountain.

From the foot of Cape Bon Ami towards Cape Rosier the coast is low and shelving.

From the violence of south-east gales the entire distance between those Capes is covered with grey limestone shingle, except at Cape Rosier lighthouse. This magnificent structure, which is the finest in the Gulf, is built upon strata of grey limestone, with alternate bands of conglomerate resembling that of Perce Mountain.

The whole is interstratified with black and grey shales.

At the base of the light house I counted upwards of 20 veins of calcareous spar, from one to three inches in width. Some of these contain cubes of galena.

From this point north-west the character of the shingle changes to that of granitic gneiss and shales, which are probably of Archæan age.

At several places along the shore toward Griffin Cove, where it is possible to remove the shingle, there are seen deposits of black ferruginous sand.

At Mr. Whalen's, in the vicinity of Cape Rosier, I was shown a large pan of this material, taken from an embankment for inspection, on my return from Griffin Cove.

From the magnetic character of this sand, and its appearance under the glass, I believe it to be same as that of the Moisie river deposit, shown to me by Capt. LeMeasuer, at Cape Gaspe. It is probably derived from the granitic gneiss.

On the Bones of "Lophius Piscatorius,"—Angler Fish, Devil Fish, Goose Fish, &c., &c.

(*Read 13th Feb'y. and 8th May,* 1882.)

1. Beginning with the frontal bone. You will notice that in this fish it is divided by a serrated suture into two parts, each having on its outer edge a peculiar dentated margin ; looking at the two parts as one bone, its central upper surface is depressed, and at about two-thirds of the length from the anterior ends it has two so-called spines on each outer edge.

2. The prefrontals of this fish, when compared with those of the Cod, have the appearance of being reversed, the side which is down in the *Lophius* appears to be uppermost in the Cod, this is in consequence of the attachment of the palatine bone to the anterior edge of the prefrontal, so that the palatine bone, with its teeth, follows nearly the line of curvature of the premaxillary. The long arms of the prefrontals are attached to the frontals underneath their outer anterior margins, and are largely supplemented with fibro-cartilage, extending between the anterior forks of the frontals.

3. The ethmoid is absent.

4. Post-frontals—each has upon it two short spines, and on its outer edge, between the spines, two depressions, the anterior the largest, and on its under side, at about the middle of the anterior depression, the bone forms an angular ridge, above the anterior edge, and in advance of which lies the orbitosphenoid.

5. The basioccipital, at its under posterior extremity, is wide, owing to the presence of thin bony plates for its attachment to the exoccipitals, and is somewhat contracted at its anterior extremity.

6. The basisphenoid is a much broader bone than that of the Cod, and has upon its lower side two arms projecting upwards and posteriorly, the wings being attached to these arms, and reaching nearly to the anterior extremity of the presphenoid. The vomer is inserted in a cavity within the presphenoidal portion of this bone.

A. Between the parietals and the posterior extremities of the frontals, lies a bone somewhat oval in shape and depressed in its

centre, it is attached to the parietals by suture, its anterior end by fibro-cartilage to the posterior extremities of the frontals, and it carries upon it the isolated ray of the first dorsal fin, together with its equivalent interspinous ray. It is a "*wormian*" bone.

7. The parietals—this fish, having no median crest, unite; near their posterior extremities they have each a small, so-called, spine, and are joined to the supraoccipital.

C. Immediately beneath the parietals, and extending from their anterior extremities, posteriorly, a little more than half their length, also supported by the exoccipitals, and extending transversely, united by a serrated suture directly under the suture of the parietals, are a pair of bones which would seem to serve in the *Lophius* the same purpose as the otoliths in the Cod fish; they are separated from the parietals in the dried skull by a delicate membrane, and on their superior surfaces are smooth and somewhat conical, having in each, on their outer margin, a deep angular depression; on their inferior surfaces they are rough and cancellated, and from the centre of their posterior margins a bar runs across each obliquely outwards to the lower margin of the depression which appears on their superior surfaces; this bar is perforated by a foramen of considerable size. I have not been able to obtain a fresh specimen of this fish in time to make a further examination of these bones.

8. The supra-occipital appears to be anomalous; it takes its rise from, and is anchylosed with, the neurapophyses of the Atlas, which together with it forms the very large foramen magnum, at the same time it forms, almost perpendicularly, a semi-circular cover to the upper posterior part of the skull, as you may see by reference to the skeleton.

9. The paroccipitals project nearly at right angles to the skull, for the peculiar attachment of the supraclavicles; looked at upon their under surfaces they are arrow-shaped, the longer blade of the arrow being on the outside, the shorter on the top of the skull.

10. The exoccipitals are very similar in shape to those in the Cod, but are each perforated by two comparatively large foramina of equal size.

11. The alisphenoids of the *Lophius* are largely supplemented with fibro-cartilage, in their attachment to the adjacent bones, and they are comparatively flat on their upper surfaces.

12. The mastoids, which are deep, short bones, together with the prefrontals, form the seat of the hyomandibulars; upon each there is a spine, and the points projecting from the outline of the skull are quite short.

13. In the *Lophius* I cannot find the squamosal.

14. The orbitosphenoids are extremely small and delicate membrane bones which lie beneath the posterior extremities of the frontals, immediately in front of the post-frontals; in their structure they are very beautiful.

16. The vomer has, in the one exhibited, at present only two teeth, one in each extremity or arm, but it may have had at one time three on each arm, most probably only two at the same time; the large skeleton before you has, as you will observe, two teeth on each arm. On its upper side, curved backward from the teeth, the vomer has a projecting bony plate forming a groove for the reception of the prefrontals, and its posterior extremity, as already stated, is inserted in the cavity of the pre-sphenoid.

17. The inter or premaxillaries are armed on their anterior edges, to their extremities with a row of teeth; those near the median line being five or six long teeth of a character similar to those on the dentary, the remainder are small but gradually increase in size toward the extremity of the bone. On their posterior edges there is a row or rows of teeth extending about half the length of the bones, and speaking generally, decreasing in size from their superior extremities. These bones are from the enormous size of the gape, long and somewhat thin plates; from their superior extremities gradually narrowing for about half their length, their breadth then increases and they terminate inferiorly in a somewhat (posteriorly) scymeter shaped edge. The processes for their attachment to the maxillaries and nasal bones are flat, and in a line following the general line of the top of the skull, but their extremities are oblique, receding from the central line.

18. The maxillaries have upon their superior extremities somewhat lengthy depressed processes for their attachment to the intermaxillaries, so that their superior surfaces lie beneath the inferior surfaces of the processes of the intermaxillaries, and they also articulate with the vomer. That they may form their connection with the articularies they are twisted at one-third of their length from the extremities of the processes already mentioned, so that their inferior are nearly at right-angles to their superior terminations. These bones gradually increase in breadth from their superior until a short distance from their inferior extremities, when they taper to a point.

19. The *Lophius* has no suborbital ring.

20. The turbinal bones (nasal—Owen) are strong and firm, having the same structure as the premaxillaries; their anterior extremities articulating with the posterior superior extremities of the premaxillaries; at this point in the living fish they are capable of considerable lateral motion, and they are attached to the premaxillaries by flat terminations in a line perpendicular to the axis of the fish; at about one-third of their length from their anterior extremities they each assume an irregular triangular form, and gradually taper to a point; at their centres they are sustained by the prefrontals, and between them lies the peculiar spine which supports the first and second rays of the first dorsal fin.

22. The palatine bones articulate between the maxillaries and the prefrontals, close to the toothed arms of the vomer, and on these bones the teeth, of which there are four to six long, and about six short (these latter generally increasing in size as they tend towards their inferior extremities), lie nearly in a line with those on the vomer. On the superior extremity of these bones are two of the so-called spines, which, as they rise above the maxillaries, are generally enumerated in descriptions of the outside of the fish. The inferior extremities of these bones are attached to the inferior edges of the pterygoids.

23. The hyomandibulars have very broad double surfaces for their articulation with their bases, and are very much enlarged at their upper posterior edges. An examination of these bones

will show you that this is essential to the support of part of the opercular apparatus. On their interior inferior terminations there are no prominent surfaces for the articulation of the stylohyals but they rest in a groove and have thin ligamentous attachment.

24. & 25. The pterygoids and entopterygoids are represented in the *Lophius* by single bones, one on each side, which are of an irregular oval form at their posterior, assuming a subtriangular shape at their anterior extremities, and have small processes which connect them with the quadrate bones. They are very thin membrane bones, and the portion below their processes may be taken to represent the pterygoids, for to them are attached primarily the palatines. The upper portion of these bones will represent the entopterygoids.

26. The quadrates, as well as the other bones connected with them, are, for such large fishes, very delicate. The condyles, for their union with the articularies, are exceedingly small, and appear on the inner sides of the bones; rising from them are ridges, folded posteriorly, against which abut the preopercular bones: below the condyles, extending posteriorly and downwards, at a small angle, these bones present somewhat broad surfaces, having at their posterior edges sharp points or spines, which, when the fish closes its mouth, are easily seen.

27. The metapterygoids are very delicate fan-like plates, having narrow thickened edges, which, at their upper arms connect with the hyomandibulars nearly in their centres. These edges are a little wider, and have projecting processes for the attachment of the ligaments which tie them to the prefrontals.

28. The opercula are long and narrow, nearly straight, bones, which articulate with the hyomandibulars just below their junction with the mastoids and prefrontals, they are almost flat on their inner, and have ridges on their outer surfaces; beginning at the centre of their superior and terminating at their anterior edges on their inferior extremities, these ridges support the subopercula; at their superior extremities, they throw out posteriorly each a long slender fin-like ray.

30. The preopercula are small and narrow curved bones, angular at their posterior edges, having ridges upon them which show

on their outer surfaces, and which support the posterior arms of the hyomandibulars; on their inner surfaces they are irregularly flattened, and terminate in an acute angle, abutting for more than half their length against the ridges which rise from the condyles of the quadrates.

32. The subopercula: these are of very peculiar form, and are attached to the anterior faces of the ridges on the opercula bones for rather more than one-half the length of the latter; they decrease in size as they rise, terminating in flatted points which lie close to the opercula; from them extend anteriorly long processes to which fibrous tissue is attached, forming the connection between these bones, the subopercula and epihyals; posteriorly, they are produced into long, fin-like rays, sixteen to eighteen in number, connected by membrane, which gives them a strong resemblance to a fin. At the bases of their anterior processes there are two of the so-called spines. The inferior extremities of the opercula bones extend a little beyond the solid part of these bones, and to about one-third of the breadth, when extended, of the fin-like rays.

33. The interopercula are somewhat triangular in shape, having upon their superior outer extremities peculiarly-shaped processes, to which, at their inner edges is attached the thin tissue connecting them with the preopercula and with the long arms of the opercula bones (not plates). From the superior outer edges of these bones descend their attachment to the epihyals from which thickened branches are sent out to support the anterior angular extremities of the singularly-shaped subopercula bones, and from their anterior extremities strong ligaments attach them to the posterior extremities of the articularies on their inner sides, enveloping at the same time the posterior extremities of the angulars. These bones lie immediately beneath the preopercula, the ossa sympletica (mesotympanic—Owen) and the posterior part of the quadrates.

31. Ossa sympletica (mesotympanic—Owen). These bones lie between the metapterygoids, the preopercula and the forks of the quadrates. They have double anterior margins for the reception of the metapterygoids and the anterior margins of the forks

of the quadrates. They are very thin narrow plates, single at their posterior edges and nearly smooth on their outer surfaces, with an irregular outline. On their under surfaces, at their superior extremities, they have short ridges nearly in their centres, extending downwards about one-third of their length. Against these ridges rest the stylohyals, which are at their upper extremities attached to grooves in the hyomandibulars.

34. The dentaries are long and narrow; at their anterior extremities they are united by symphysis, and support two rows of teeth upon their inner surfaces, one of full size, and the other in various stages of growth; on their lower anterior extremities there are processes for muscular attachment, and on their posterior inner surfaces is the space for *Meckel's* cartilage.

35. The articularies fit into the spaces or grooves of the dentaries. On their upper surfaces the superior anterior faces join the dentaries in sharp points and widen posteriorly to a considerable breadth; at nearly their superior posterior outer edges each has a projecting spine, and on the inner inferior edge processes for connection by ligament with the quadrates; immediately posterior to the spines is the articulation for the condyle of the quadrates. The heads or posterior extremities of these bones extend about one and a quarter inches beyond the anterior edge of the articulation, and upon them rest the spine and the superior part of the broad inferior extremity of the quadrates. From the superior posterior extremities of the dentaries the posterior extremities of the articularies reaching to the anterior edge of the articulation for the condyles of the quadrates rapidly fall, and form a triangular surface, which appears to be for the attachment and play of the maxillaries.

36. The angulars are exceedingly small and thin flat bones, situated on the inner sides of the posterior extremites of the articularies. They have small heads, which are turned outwardly and overlap the articularies.

29. Stylohyals. These bones, as already mentioned, lie in grooves in the hyomandibulars, and are small and somewhat tapering towards their superior extremities and have a ligamentous attachment.

37. Epihyals: these bones are long. At their posterior extremities they are narrow and curved inwards and upwards towards their junction with the stylohyals. They widen out at their anterior extremities, where they present themselves as thin bony plates. On their upper inner anterior edges there is on each a splint, which unites it with its

38. Ceratohyal: these, which are comparatively very long bones, have at their superior anterior extremities processes which connect them with the epihyals, giving to them *in situ* the appearance of having thickened superior edges. The Ceratohyals on their lower posterior extremities present the same thin edges and of equal width with the epihyals. In the anterior third of their length, midway in these bones, on the outer side, is a groove for the reception of part of the branchiostegal rays, of which two on the inner side of the bones are the anterior, and four on the groove mentioned the posterior. At about half their length on the superior surfaces there is on each of these bones a process for their attachment by ligament to the angulars and dentaries, and at this point the bones are twisted so that their inferior are nearly at right angles to their superior extremities.

39, 40. Basihyals: these bones, two on each side form the base of the hyoidean arch; in the *Lophius* they are of irregular shape, and the upper pair present long posterior processes which unite them by sqamuous suture to the inner side of the ceratohyals at their upper anterior extremities; the lower pair are small, thin and somewhat triangular plates, which are attached to the lower anterior extremities of the ceratohyals. In the Cod the lower pair are much the larger bones.

41. The glossohyal, which lies between the basihyals and the

42. Urohyal, which is directly beneath it, are both extremely small bones.

43. The branchiostegals are very long and thin bones. There are six on each side, and in the absence of ribs they serve to form the large abdominal cavity of the Lophius.

53. There are in the Lophius no representatives of the basibranchials.*

* I have not yet found any; but will make further examination as soon as a new specimen is obtained.

56. The lower pharyngeals are flat, and have at their posterior extremities a somewhat spatulate shape, gradually tapering to their anterior extremities, from which points to about one-half of their length they are strengthened by lateral ridges; on their outer and inner edges it may be said there are two rows of teeth occupying the anterior two-thirds of their length, the posterior third is for the attachment of the muscles, and between the rows of teeth the bones are somewhat rough.

57. The hypobranchials are not represented in the Lophius as in the Cod by three bones, but the inferior (anterior) extremities of the ceratobranchials of the three first branchial arches are prolonged curving inwards and posteriorly, and tapering to points they rest in, and are supported by the fibrous tissue of the floor of the mouth.

58. Ceratobranchials—the first three pairs of these bones are thin and delicate and there is a comparatively wide space between their inferior extremities; the fourth pair are longer than the others, but their inferior (anterior) extremities are slight and a short distance apart, but tied together by tough fibrous tissue which also serves to support the inferior extremities of the lower pharyngeals.

61. The epibranchials—the first pair in the Lophius are only short representatives of these bones and they do not rise to the support of the upper pharyngeals, but are attached to the ceratobranchials of the first arch in the usual manner, and to the epibranchials of the second arch, of which they are about one-third the length, their superior extremities fitting into a groove in the epibranchial to which they are also attached by ligament. At about their centres they throw out anteriorly, processes, which are slightly curved inferiorly, for their attachment to the muscles which govern the branchial arches. The second pair of epibranchials are long and slender bones having expansions for the junction of the first pair, and at each extremity for their attachments inferiorly to their ceratobranchials, and superiorly to the anterior division of the upper pharyngeals, immediately beneath the process for the muscular attachment of this division. The third pair of epibranchials taper slightly from their junc-

tions with their ceratobranchials to about midway of their length, they then gradually enlarge until they reach the upper pharyngeals, to the median division of which they give partial support; at their upper third these bones are closely connected with the fourth pair, and are for a short space enveloped by them, in fact forming on each side a nearly rigid pair. At the superior extremities of these bones on the anterior faces of the median upper pharyngeals are processes for their muscular attachment. The fourth pair are longer and very much stronger bones than the others, being at their inferior extremities in proportion to the others as ten to three; on their posterior edges they are somewhat thin with double anterior ridges; they decrease in size until they reach the third pair, where they expand with shell shaped processes, which as already stated, partially envelop the bones of the third pair; at the junction with their upper pharyngeals they are less in size than at the enveloping process, and also tend to support the median division of the upper pharyngeals, while the posterior division may be said to be entirely sustained by them.

62. The upper pharyngeals contain each three plates or divisions (anterior, median and posterior), armed with teeth strongly curved posteriorly. The anterior divisions contain each ten to twelve teeth, and are narrow, having processes on their superior extremities for attachment of their muscles. The median divisions are somewhat triangular in shape, and their superior edges (the bases of the triangles), are more than four times the breadth of either of the other divisions; they have each on their superior edges a process for their muscular attachment, and each contains from eleven to fifteen teeth. The posterior divisions are also narrow plates; at their anterior inferior edges they are curved under and connected with the under posterior surfaces of the second divisions; on their superior edges there are processes for muscular attachment. These divisions contain each from ten to fourteen teeth.

46. In the Lophius the supra clavicle (sometimes called the post temporal) is on each side a broad spatulate plate, thin upon its edges, gradually rising to form a ridge along its anterior

centre: at about one-third of its length from its proximal extremity, the ridge mentioned becomes reduced, and this extremity droops so as to form its articulation immediately beneath the paroccipital and against the exoccipital, thus lying nearly at right angles with the vertebral column.

47. In this fish the interclavicle is not represented.

48. The clavicle is very difficult to describe; from the proximal extremity of its upper limb to midway of the lower limb, lines drawn through the centres of these portions of the bone would in general terms form a right angle; they are not unlike the wooden knee of a ship in the curve formed by the upper and lower limbs, the lower half of the lower limb curving towards the centre of the fish. Upon its proximal superior extremity the bone curves upward, and projecting above the supraclavicle, forms one of the spines of the head. A very long and strong spine rises just above the point of junction with the distal end of the supraclavicle. Upon the outer edge of the clavicle there is also a process for the attachment of the muscles, and at about one-third of the length (from its inferior extremity) of the lower limb of the clavicle, rises the ligament which serves for the attachment of the pelvic limbs.

49. Accessary bone: at the base of the long spine at the upper outer posterior edge of the clavicle, and attached to it, is the accessary bone (post clavicle, of some); it is thin and delicate.

52. Scapula: close to the accessary, and upon the clavicle, and close to its outer edge, is the very small fenestrate scapula, and immediately beneath the scapula, attached to its inferior edge, but lying, its central limb in the centre of what may be called the junction of the upper and lower limbs of the clavicle, is the (51) coracoid, which is an irregularly oval cup-shaped bone, the edges of which are attached to the clavicle, and from its apex a thin process projects angularly towards the outer edge of the clavicle, to which it is attached by cartilage.

53. The carpals, or brachials, in the Lophius, are (on each side) two in number, they are very long and are attached to the scapula, the coracoid, and to the clavicle. The upper carpal being about half the length of the lower, does not bear fin rays,

but serves for the support of the lower carpal, (which is also much stronger than the upper), as well as to the fin rays of the superior edge of the pectoral fin. The lower carpal at its lower posterior half, at the point of junction with the inferior extremity of the upper carpal, has a thin posterior edge which continues to its distal extremity, and round which, beginning at the junction with the upper carpal and continuing to its anterior inferior edge, the twenty-seven rays of the (65) pectoral fin are attached.

80. The pubic bones which support the ventral fins are each attached by a strong ligament to the clavicle (see 48) of its side at its upper edge, about the point where the posterior cartilage enters and is covered by the bone. The iliac portion, if it may so be called, being a shaft (containing cartilage), somewhat flattened at its anterior extremity, decreasing in size towards its centre, from whence it widens out to form the ischio-pubic elements, on the outer edge of which the six fin rays are attached, the posterior (82) five being soft rays, and the anterior ray (81) a comparatively short and strong spine, which has in most cases a slight upward and outward curve.

67, 68, 69. The vertebral column contains twenty-nine vertebræ. The Atlas as already mentioned (under No. 8), supports the supra-occipital; the atlas, axis and the third and fourth centra are wider on their superior and inferior surfaces, particularly the two first named, than the remaining centra which gradually taper to the caudal extremity. The vertebræ interlock on their inferior edges by angular processes, while their superior anterior edges are interlocked or supported by the neurapophyses of each succeeding centrum overlapping the posterior edge of its preceding neurapophyses, and they gradually decrease in size until about the nineteenth centrum, from this point being nearly of the same size to the twenty-seventh. The twenty-eighth and twenty-ninth centra have their superior processes very small, but the inferior interlocking processes are of the normal size. The axis is the shortest centrum in the column, being about half the length of the atlas, and not more than half its height at its outer edges. The twenty-eighth cen-

trum is about the same length as the twelfth, and the twenty-ninth is double the length of any other centrum.

The neurapophyses and neural spines. The processes rising from the atlas and supporting the supraoccipital may probably be looked upon as modified neurapophyses; those of the axis and third centrum at their inferior extremities having a greater space between them as these centra are wider than the others, the remaining neurapophyses conforming to the centra to which they are attached. The neural spines rise in height gradually from the axis to the ninth centrum, slightly fall at the tenth, maintain their height to the fourteenth, and diminish gradually to the twenty-first; the twenty-second and twenty-third meet with somewhat rounded points; the twenty-fourth, fifth, sixth and seventh are again slightly prolonged, but the structure of their posterior extremities is much like that of their centra. The posterior edge of the twenty-seventh centrum shows slight increase in median diameter, but the form of the twenty-eighth centrum is different from that of the others, it is marked by a prominence on its median line at each side, and at its posterior extremity the neural spine overlaps the twenty-ninth centrum for about one-half of its length. The twenty-ninth centrum has, extending for nearly two-thirds of its length from its anterior edge, on each side, a broad wing-like process beginning below the prominences on the twenty-eighth centrum, slightly rounded at its outer edge and drooping a little towards its posterior extremity; near its superior posterior extremity this centrum is rounded somewhat and flattened, and at its extremity, it is transverse to the vertical line: the termination of this centrum which supports the caudal fin is vertically narrow and perpendicular to the column. The neural spine appears in this centrum to be represented by an intercalated curved bone, the centre of which lies just posterior to a line drawn through the posterior edge of the anterior third of the centrum, and there are two foramina at the base of the neural canal, below the anterior extremity of the intercalated bone.

The two centra twenty-eight and twenty-nine, appear to be the analogues of the sacrum.

The Ventral aspect of the vertebral column: The Axis has no parapophyses, but at its anterior inferior edge a rounded ridge for its articulation with the basi-occipital, and from the posterior edge of this ridge there is an upward curve, which causes the posterior to be in vertical height to its anterior edge as three to five; the curve mentioned is continued in the axis and third centrum, making the vertical height of the three named less than that of the remaining centra, and not affecting the dorsal line.

The centra, from the axis to the fourteenth, gradually increase, and from the fourteenth to the eighteenth, decrease in vertical height; the remainder are nearly of the same height. It may be observed that while in most of the centra the conical cavities are of greater transverse breadth than vertical height, the reverse is the case in some of the posterior centra, with the exception of that between the twenty-eighth and twenty-ninth centra.

Between the basi-occipital and the anterior face of the atlas, the usual conical cavities exist, but the atlas taken by itself is neither amphicœlous nor procœlous, the conical cavity is found in its anterior face, extending deeply into the centrum, and the posterior *facet* has transversely a small anterior curve, but vertically at its central line it has a straight surface, inclining anteriorly, which causes a slight difference in the length of this centrum, between its upper and lower surfaces, the latter or inferior aspect being the shortest. The axis, which is very short, and the remaining centra, are amphicœlous.

The parapophyses of the axis and third centrum are very minute, if even they can be said to exist; they begin to appear on the fourth, and continue to and upon the *ninth centrum.

The hæmal arches are completed upon the tenth and eleventh centra by the coalescence of the hæmapophyses. The hæmal spines appear on the twelfth, thirteenth and fourteenth centra, and following the general line of the vertetral column, each lies in the anterior space between its posterior hæmapophyses. The spine of the * fifteenth centrum at its posterior extremity has a

* This is variable, as smaller and likely younger specimens show. In one the hæmapophyses do not coalesce until the fifteenth centrum; in another upon the eleventh, and in both of the above the parapophyses continue to and upon the tenth centrum, and also these two specimens show the curved hæmal spine upon the fourteenth centrum, these fish had only ten rays in the anal fin.

slight downward curve, and on the sixteenth it has attained its normal length and angle, and from this, to and including the twenty-seventh centrum, the spines gradually decrease in length and angle. The hæmal spine* of the twenty-eighth centrum is much elongated, and is almost parallel with its neural spine, it extends posteriorly beneath the twenty-ninth centrum for two-thirds of the length of the latter.

On the twenty-ninth centrum there is no hæmal spine, unless a somewhat thick and flattened edge on its posterior extremity may be said to represent it. In the wing-shaped processes at each side there is a foramen for the vessels, slightly posterior to the termination of the hæmal canal proper.

74 & 75. Dorsal fins. This fish has two dorsal fins, the first containing six spines, two of which are close together and near the nostrils, and are supported by a very peculiar dermal longitudinal spine situated between the turbinal or nasal bones; looking upon the superior surface of this spine, at its anterior extremity there is a narrow perforated projection which joins the apex of a flat kite-shaped process, the posterior extremity of which terminates in a sharp point curved slightly above the general line of the spine, and beneath which the spine has a flattened superior edge widening to its posterior extremity where it is quite thin and flat. On its anterior half the spine has at its anterior extremity, vertically, a very thin and deep plate, which is strengthened by the flattened edge and process above mentioned; this thin plate at its anterior inferior extremity is rounded, and curves posteriorly towards the middle of the spine and there disappears. As already mentioned the anterior portion of the longitudinal spine lies between the turbinal bones, and its anterior extremity is slightly in advance of the superior processes of the maxillaries; its posterior extremity extends to nearly the centre of the forks of the frontals. The length of the spine varies in different specimens, a small fish having sometimes a proportionately longer spine than a large one. The spine is enveloped by muscles which control its movements, as well as

* In one specimen before me, the length of the spine is nearly one and a quarter inches, while that of the twenty-ninth centrum is one and five eighths inches.

those of the first and second spinous rays of the first dorsal fin.

The first spinous fin ray articulates with the perforation in the longitudinal spine by what at first appears to be a bony link-joint, but the bifurcated inferior extremities of the fin ray are tied together by a firm cartilage, which, passing through the perforation or ring of the longitudinal spine completes the link-joint. Usually the first fin ray has upon it a fleshy looking lappet, which is supposed to be the bait this fish displays to attract its prey, but another use of it appears to be to warn the fish when it is in shallow water. This lappet is often lost by the fish and is said to be reproduced in a short time ; when the large specimen was caught, it was without this bait, and it is possible that old age may put a stop to the process of recuperation.

The second spinous fin ray articulates with the longitudinal spine at the posterior extremity of the kite-shaped process, and is partially supported by it ; the bifurcated extremities of this ray are much closer together than those of the first ray.

The third or isolated spinous fin ray, rises from the centre of the depression in the bone already referred to as "A," which has upon it a small longitudinal spine for its articulation ; it is much shorter than the first two spinous rays, and in a large specimen, six inches behind the second spinous fin ray. The three remaining, or the fourth, fifth and sixth spinous fin rays cover a space of about three inches, the fourth being about three and a half inches in height, the two others successively shorter ; the fourth ray (in the specimen above mentioned) is distant from the third, four and one-half inches, and all three lie above the vertebral column ; the fourth ray above the neural spine of the fourth centrum, the fifth above that of the sixth, and the sixth ray above that of the seventh centrum, each having also above the column a small and nearly longitudinal spine which carries almost in its centre a small crest, behind which the fin ray articulates.

The second 'dorsal contains twelve soft rays, supported by twelve (74) interneural spines ; the first spine is inserted between the eleventh and twelfth, and the twelfth between the twenty-second and twenty-third neural spines, and they are strongly bent

posteriorly, their anterior faces lying against the posterior edge of their anterior neural spine, while their superior extremities rise above their posterior neural spine. The first ray of the second dorsal is supported by the superior posterior extremity of the first interneural spine, and the anterior face or angle of the second, and so on until the twelfth, which is sustained by the posterior extremity of the twelfth interneural spine, slightly in advance of the posterior extremity of the twenty-fourth centrum ; this last interneural spine is attached by its posterior extremity to the neural spine of the twenty-fourth centrum. The fin rays of the second dorsal, increase in length from the first to the sixth, and then decrease to the twelfth ray.

71. The caudal fin contains eight soft rays, the centre two of which are the longest, and about of equal length ; the upper and lower rays, also of about equal length, are the shortest, and the fin when spread, presents at its posterior extremity a rounded outline. The two divisions of the upper ray on their superior edges, as well as those of the lower ray on their inferior edges, unite, and form each an angular edge, but that of the upper ray is much the stronger.

83. The anal fin and interhæmal spines.

79. The interhæmal spines of the anal fin, are ten in number ; the first lies between the fifteenth and sixteenth, and the last two or ninth and tenth, between the twenty-third and twenty-fourth hæmal spines, that is both on the twenty-fourth centrum. The fish described has *eleven* anal rays, the first of which articulates with the anterior edge or angle of the first interhæmal spine ; the second with the anterior angle of the second interhæmal, and is also supported by the posterior extremity of the first, and thus they continue to the tenth ; the eleventh fin ray is attached to the posterior extremity of the tenth interhæmal spine, immediately beneath the centre of the twenty-fifth centrum. The rays of the anal fin increase in length to, and including the seventh, and decrease slightly to the eleventh. In most specimens, the Lophius presents in the anal fin only ten rays ; in these the first interhæmal spine may be inserted between the fourteenth and fifteenth, or between the fifteenth and six-

teenth, and the last two between the twenty-second and twenty-third, or between the twenty-third and twenty-fourth hæmal spines, in other words upon the twenty-third or twenty-fourth centrum, (I have specimens of both before me), in this case the last interhæmal spine is very short and does not reach the extremity of its posterior hæmal spine.

72. The Lophius has no ribs.

In conclusion, I would mention that the foregoing paper when read, was illustrated, by the disarticulated bones of the skull, &c., as well as a skeleton of a Lophius, together with the disarticulated bones of the skull, and a skeletal head and shoulder-girdle of a codfish (Gadus morrhua).

ART. VII.—ON THE RAVAGES OF THE TEREDO NAVALIS, AND LIMNORIA LIGNORUM, ON PILES AND SUBMERGED TIMBER IN NOVA SCOTIA, AND THE MEANS BEING ADOPTED IN OTHER COUNTRIES TO PREVENT THEIR ATTACKS. BY MARTIN MURPHY, ESQ., *Provincial Engineer.*

(Read Monday evening, 13th March, 1882.)

AMONG the questions which interest the engineer in the Maritime Provinces of the Dominion of Canada, there are none of greater importance than the means whereby the ravages of the Teredo Navalis can be checked or prevented. I think I may say that here, as in many other instances, where the operations of nature interfere with the designs of man, we can only remedy these difficulties by a precise knowledge of their causes, a knowledge which may enable us, if not to check, at least to avoid, some of the evil consequences. We know that innumerable boring animals establish themselves in the lifeless trunk of the piles and other submerged timbers of our wharves, piercing holes in all directions into their interior, like so many augers, penetrating the timber in every direction, until they actually destroy its solidity, and dissolve its connec-

tion with the ground. But however efficient these borers may be, science comes to the rescue, and means are being successfully adopted in both Europe and America to not only resist, but to effectually destroy their attacks.

I need only allude to the universal knowledge of the danger to be apprehended, arising from the growth and development of the Teredo within the bearing timbers which support our railway bridges; to the annual loss to both the Dominion and Provincial Governments arising from their destructive powers upon our public road bridges, wharves and breakwaters, to satisfy the most sceptical that a study of this subject is worthy of the deepest scientific interest; and that a minute knowledge of the extent and mode of formation of those belonging to our own shores must be of paramount importance, were it only with reference to the preservation of timber from their attacks. For although efforts are being made to replace our timber bridges by iron, still, when it is remembered that owing to our great extent of sea coast, to the many indentations of the sea, or harbours which run far inland, and that are necessarily crossed over tidal water, and that timber is within easy distance, and labour, skilled in fashioning it into desirable form, is always available, it may yet be a long time before all the timber bridges in this country will be superseded by more permanent materials. The same remarks will more fully apply to the wharves and breakwaters of the Maritime Provinces of Canada; for until timber in this country becomes much more expensive than it is at present, it will be more economical to adopt in many situations the class of wooden structures, or stone and wood, as at present existing.

These facts suffice to show that the reasons so far given for the necessity of investigating the ravages of the Toredo, and the other destructive species of its class, are in themselves a subject well worthy of investigation; and the author of this paper would respectfully solicit the aid of the President and members of this Institute, many of whom are much more conversant with nature and its fauna and flora than he could pretend to be, the object in view this evening being more to explain what is being done by Engineers to prevent, or at least to lessen, the evil consequences

of their attacks, than to discuss the several species of molluscs which perpetrate them.

Let us now return from this digression to the consideration, first, of the abode of the Teredo in Nova Scotia.

From a series of investigations for the purpose of this paper, the author is led to believe that the Teredo Navalis, or the Teredo Norvegica, exists all along the shores of this Peninsula. The zone or area of its active operations is, however, confined along the shore bounded by Northumberland Strait, St. George's Bay, Strait of Canseau, Chedabucto Bay, and all round Cape Breton Island. South and West of these places its attacks are not very remarkable, the Limnoria Lignorum being more conspicuous for its depredations along the Atlantic Coast, from Chedabucto Bay to Cape Sable and along the shores of the Bay of Fundy. It is very remarkable that in Nova Scotia the haunts of the Teredo, where its ravages are greatest, indeed where its destruction is very noticeable, are confined to bays, harbours or estuaries that are frozen over from four to five months of the year. From Cape Sable to Cape North, 370 miles, we have a much greater diversity of climate than is due to latitude alone. The influence of the gulf stream on the southwestern promontory gives a milder and more tepid atmosphere, with harbours open all the year round. The influence of the ice floes in the Gulf of St. Lawrence on our northern and more eastern coast, has quite the opposite effect. Here where our harbours or rivers are sheltered from agitation of the sea, they are frozen over, and here is seemingly the place where the Teredo appears to live, thrive and destroy.

At Shediac I have seen a spruce stick, that had been driven as a fender pile to the wharf one year previously, completely honeycombed so that it floated to the surface. I saw living teredos in it from 4 to 6 inches in length. I am sorry I did not know enough at the time, to notice the shell or pallets which distinguish the species.

At Pictou the Teredo is very destructive on both sides of the harbour, almost every piece of submerged timber bears traces of its ravages.

The specimens of its borings obtained from Pictou, which I place before you, leave no doubt that it is the work of the Teredo.

At the Pine Tree Gut, about six miles from New Glasgow, and eight from Pictou, where the railway crosses the tidal estuary, the Teredo has attacked the piles of the railway bridge, which we shall hereafter refer to.

At the marine slip, Strait of Canseau, distinct traces of the work of the Teredo are quite visible.

At Sydney, C. B., every wharf suffers by their depredations, except the pier of the Sydney and Louisburg Railway, which is an example of how their attacks can be prevented. I shall hereafter refer to this structure.

At Louisburg, and at Margaree, they are also quite active, so that I think we may fairly assume that they are to be found in the other harbours intermediate between those places.

Returning to the Strait of Canseau, and proceeding westwardly towards Halifax, we are in the region of the Limnoria Lignorum, and although traces of the Teredo may be found at the ship yards and marine slips all along our shores further south, yet they are neither numerous nor destructive. The wood eating Limnoriæ now become the active agents of destruction. Myriads of them are visible on the piles of our wharves, and on every piece of submerged wood within the zone of their attack. From Whitehaven to Halifax, at Mahone Bay, Lockeport, Shelburne, Yarmouth, St. Mary's Bay and at Digby the attacks of these little borers are vexatiously conspicuous. A pile at the old yacht club house in Halifax Harbour, 12 inches in diameter, was reduced to 6 inches in seven years. Along the Atlantic shore they destroy timber over its submerged surface within the limits of its workings at the rate of about one inch per annum. Specimens from Digby, which I submit, show a much less degree of destruction. Those four specimens of piles, taken from Digby wharf, 13 years submerged, were, when driven, 10, 12, 13 and 15 inches respectively, they are now 6½, 5, 7 and 6 in the order in which they are first named. Along St. Mary's Bay, Annapolis Basin, and Minas Channel, inlets of the Bay of Fundy, the average rate of destruction seems to be about the same as at Digby, namely,

about one-half inch on the exposed surface per annum, or about one-half as much as at Halifax, and some other places on the Atlantic coast. In 1877 one of the piers of the Victoria bridge, which crosses Bear River near its confluence with Annapolis Basin, toppled over, owing solely to the borings of the Limnoria Lignorum. It had been constructed about 10 or 11 years, and was erected thus:

1st. Cribs were built of logs, floated to the site of the piers, and there sunk by stone.

2nd. Around the submerged crib-work a single row of piles was driven at a distance of three feet apart centres.

3rd. On the rectangular single row of piles the piers were erected, which then, stilt-like, supported the whole weight of superimposed pier and superstructure.

Many of the piles suffered so much from the attacks of these crustacea, that several of them floated away with the tide, causing the pier to tilt over and carry the bridge superstructure with it into the stream below.

At the lowest spring tides known for that year, I visited the lower trunk of the pier which still remained standing, with the view of having it renewed. Every pile was eaten at the level of low tide to about three inches from the former surface, until its section became so reduced as not to be able to support the superimposed weight above. The timber consisted of spruce, hemlock and pine,—the attacks seemed to be just the same on each, irrespective of kind. I would here mention that the same remarks apply to hardwood, such as black maple and oak.

I will now briefly advert to the animals themselves.

Dr. E. H. Von Baumhauer, Commissioner to the Centennial Exhibition from Holland, in papers published in the "Popular Science Monthly" for August and September, 1878, gives, through the translation of Mr. Andrews, the following very full and interesting description of the habits and workings of the Teredo Navalis, as extracts from the "Archives of Holland" or extracts from the report of the Dutch Commission, on the subject under your consideration.

"Teredos penetrate wood naturally by very small openings in

a direction perpendicular to the surface (Figs. 12 and 15–C); then they generally turn about in order to follow the direction of the woody fibres, usually upward, but sometimes downward. Although they do not enter into the earth or mud, one generally finds the first traces immediately above the line of the mud in which piles are driven; it is at this point that piles destroyed by the teredo generally break off.

"When the teredos are lodged in a piece of wood, one recognizes them by very small holes on the surface, and the extremely delicate tubes which project from them (Fig. 12, e, d). These are the siphons, only one of which shows at first, the other appearing later. These siphons are generally kept outside the wood in the water, but the slightest touch causes the animal to retract them. One of them is shorter and larger than the other, but they both seem to serve for the expulsion of the fæces, which largely consist of particles of wood reduced to a very fine powder. It is known that the teredo does not perforate wood for nourishment, but only to procure a suitable abode; the woody substance detached in the boring, passes through the intestinal canal, and then is expelled in the form of a very fine white substance by one of the siphons, generally, according to M. Vrolik, by the shorter, but sometimes by the longer. The long siphon appears to serve principally for the introduction of food, which consists of infusoriæ diatoms, and other inferior animalculæ which the sea-water brings with it into the siphons. It is nevertheless still uncertain whether the matter expelled through the longer siphon comes directly from the intestinal tube, or is at first introduced from outside with inflowing water to be expelled again after a short sojourn inside.

"The Teredo requires for respiration a clear, pure water. It has often been remarked that piles placed in dirty, muddy water, near drains, for example, are protected thereby. The water should have, moreover, a certain degree of saltness; the teredo cannot live in brackish water: that is a point to which we shall return later.

"The Teredo continues to grow in the wood; while the gallery which it forms presents near the surface a diameter of only

one quarter to half a millimetre, it enlarges little by little, until it reaches a diameter of five millimetres and more; as regards his length, and consequently that of the tube which incloses him, we have sometimes found it to be thirty to forty centimetres. He never goes upward more than half way between the flow and ebb of the tide; although the teredo is thus, for a short time, partially above the water, yet it appears that the wood holds a sufficient amount of moisture to sustain his life temporarily.

"The researches of Kater have still further shown, what had already been remarked by Sellius, that the Teredo can hibernate in the wood, and that it is those individuals, thus preserved, which in the spring go through with all the phenomena of reproduction —i. e., the formation of eggs, fecundation, development, and expulsion of the young.

"The part of the external integuments which constitutes the mantle deposits a calcareous matter, forming an interior lining to the gallery in the wood (fig. 12. f.) Between this calcareous casing and the body of the animal there remains a space sufficient to prevent any inconvenience, at least during the act of respiration, for it is possible that when the Teredo absorbs water, which serves for respiration, his body is distended, and fills exactly the calcareous tube. The form of this tube, secreted little by little, corresponds exactly with that of the gallery, which has been slowly perforated in the wood; it has the appearance, also, of a series of rings placed one against the other. As the animal progresses a new ring is added to those which existed before, so that when the tube is closed at its extremity by a calcareous film, its length represents the total length of the animal. (fig. 12; b to c) Among the segments of the tube, those which are nearest the surface of the wood are the oldest and hardest; in the interior of the wood, where the gallery ends (fig. 12, g), the calcareous ring, newly formed, is at first soft, flexible, and of slight consistency; later, it becomes solid, and closes up the tube, as has been remarked by Sellius.

"The calcareous tube, once formed, constitutes for each Teredo his own abode, where he isolates himself from his companions,

and has nothing to fear from their close proximity. One never sees a Teredo pierce the tbue of another. The tubes make their way side by side, and cross each other in every direction, but, be the wood ever so worm-eaten, there always remains a woody wall, often very thin, it is true, between two adjoining tubes."

I think this description by the Dutch Commission is so full and comprehensive, that it leaves but little to add to the mode of sustenance and attack of the animal, which is all I shall advert to here. Suffice it to say, that the characteristics so explicitly described are largely if not fully applicable to the species of Teredo inhabiting our shores.

Let us now return to a review of the habits and attacks of the Limnoria Lignorum, so destructive from Chedabucto Bay westerly and along our Atlantic coast and the shores of the Bay of Fundy.

The piece of pile alluded to taken from the old Club house wharf at Halifax, was sent to me by Mr. Peter Archibald, C. E., Resident Engineer of the Intercolonial Railway. It had been in the water seven years,—was 12 inches in diameter when placed there, and was reduced to six inches by the action of the Limnoria. I received it just as it was taken out; one could observe with the naked eye the crustacea then living. I had it placed in sea water, and sent to Notman's Photographic establishment here to be photographed. The operator found no difficulty in obtaining a negative of the piece of wood which I produce, and enlarging it about four diameters. It was very difficult, however, to find a single perfect specimen; they all died when about one day from their abode in the harbour, and owing to their diminutive size, they had so shrivelled up as not to be recognizable. Fortunately, Rev. Dr. Honeyman had a specimen which I obtained, and which is shewn enlarged about four or five diameters; it is procured from the same neighbourhood. Two views are shewn, the dorsal and ventral.

Owing to the vrey able and comprehensive description of the Limnoria Lignorum given by Professor Baird, in his Report of the sea fisheries of the south coast of New England in 1871–72, we are able to place this wood borer in the order of its species as one of the crustacea. At page 379 Dr. Baird says:

"Of Crustacea, the most important is the Limnoria Lignorum. (p. 370 Plate VI, fig. 25) This little creature is grayish, and covered with minute hairs. It has the habit of eating burrows for itself into solid wood to the depth of about half an inch. These burrows are nearly round, and of all sizes up to about a sixteenth of an inch in diameter, and they go into the wood at all angles, and are usually more or less crooked. They are often so numerous as to reduce the wood to mere series of thin partitions between the holes. In this state the wood rapidly decays, or is washed away by the waves; and every new surface exposed is immediately attacked, so that layer after layer is rapidly removed, and the timber thus wastes away and is entirely destroyed in a few years. It destroys soft woods more rapidly than hard ones; but all kinds are attacked except teak. It works chiefly in the softer parts of the wood, between the hard, *annual layers*, and avoids the knots and lines of hard fibre connected with them, as well as rusted portions around nails that have been driven in; and, consequently, as the timbers waste away under its attacks, the harder portions stand out in bold relief. When abundant it will destroy soft timber at the rate of half an inch or more every year, thus diminishing the effective diameter about an inch annually.

"Generally, however, the amount is probably not more than half this; but even at that rate, the largest timbers will soon be destroyed, especially when, as often happens, the Teredos are aiding in this work of destruction. It lives in a pretty narrow zone, extending a short distance above and below low water mark. It occurs all along our shores from Long Island Sound to Nova Scotia. In the Bay of Fundy, it often does great damage to the timbers and other wood-work used in constructing the brush fish-weirs, as well as to the wharves, &c. At Wood's Hole it was formerly found to be very destructive to the piles of the wharves. The piles of the new Government wharves have been protected by broad bands of tin plate, covering the zone which it chiefly affects. North of Cape Cod, where the tides are much greater, this zone is broader, and this remedy is not so easily applied. It does great damage, also, to ship timber floating in the docks, and

great losses are sometimes caused in this way. Complaints of such ravages in the Navy Yard at Portsmouth, New Hampshire, have been made, and they also occur at the Charlestown Navy Yard, and in the piles of the wharves at Boston. Probably the wharves and other submerged wood-work in all our sea ports, from New York northward, are more or less injured by this creature, and if it could be accurately estimated, the damage would be found surprisingly great.

"Unlike the Teredo, this creature is a vegetarian, and eats the wood which it excavates, so that its boring operations provide it with both food and shelter. The burrows are made by means of its stout mandibles or jaws. It is capable of swimming quite rapidly, and can leap backward suddenly by means of its tail. It can creep both forward and backward. Its legs are short and better adapted for moving up and down in its burrow than elsewhere, and its body is rounded, with parallel sides, and well adapted to its mode of life. When disturbed it will roll itself into a ball. The female carries seven to nine eggs or young in the incubatory pouch at one time.

"The destructive habits of this species were first brought prominently to notice in 1811, by the celebrated Robert Stephenson, who found it rapidly destroying the wood work at the Bell Rock light house, erected by him on the coast of Scotland. Since that time it has been investigated, and its ravages have been described by numerous European writers. It is very destructive on the coasts of Great Britain, where it is known as the "gribble."

If we contrast the destructive powers of the two most remarkable wood borers inhabiting our shores we find a great diversity in size, form, mode of operation, mode of existence and attack.

The Teredo, as we find it, is from four to six inches long, and about $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. The Limnoria is about 1-16 to 1-8 of an inch in length, and about one half that thickness. The Teredo is long and vermiform; the Limnoria is short and ovate. The Teredo bores to make itself a house. The Limnoria bores for existence. The Teredo lives on the infusoria of the water: the Limnoria on the substance of the wood itself.

The Teredo attacks from the outside, and penetrates into the

heart of the timber; the Limnoria attacks from the outside only, and rarely more than one half an inch, until the cells are destroyed by the water, when it renews its efforts and destroys again.

From these facts it will be seen that the preventive measures to be taken in order to counteract the attacks of these two classes of borers, should be quite different. For instance: the means to be devised for the preservation of wood from the attacks of the Teredo in the harbour of Pictou should be entirely different (preventively considered) to those which should be employed in the harbour of Halifax. To arrest the destruction going on by the Limnoria Lignorum, one means must be used so as to permeate every pore of the wood internally; the other need only to be applied externally, so as to fill up the half inch cavities or cells visible on the outside of the timber, or both destroyers may be warded off by a metallic covering, so as to prevent them from attacking the wood at all.

That the Teredo existed in Europe, in a geological period earlier than our own, does not admit of a doubt. At Belfast, Ireland, 12 feet under the surface in a blue argillaceous soil beneath a series of strata of shells, in the London clay, in the Eocene formations at Brussels, and also near Ghent, fossil wood containing the remains of the Teredo has been found.

An idea prevails that the Teredo was imported from abroad through vessels coming from the East Indies to Europe; but this is said to be an erroneous impression. The same idea prevails here, that it was imported from the West Indies through the same means, and it may be found equally fallacious. It is obvious that the Teredo in Nova Scotia does not seek the most southern and warmest haunts.

One of the circumstances favoring the ravages of the Teredo is said to be saltness of the water; it is not found in brackish water here; and owing to the narrowness of our Peninsula (not more than 100 miles at the most) the small consequent water sheds, and the small volume of water poured from them into our harbours, we cannot say much on this point. I have, however, nowhere observed the Teredo active near fresh water.

The Teredo finds himself exposed to the attacks of an anne-

lide which is constantly found wherever the Teredo exists. His eggs and embryos are met with in the midst of those of that mollusc.

Kater has remarked that the adult annelide leaving the muddy bottom where he has hibernated, and in which the piles are driven, climbs along the surface of the wood toward the opening made by the teredo; there he sucks away the life and substance of his victim; then, slightly enlarging the aperture, he penetrates and lodges in place of the teredo. All the early writers on this subject state that they have found this annelide in wood at the same time with the teredo. It is remarkable that a similar annelide, and perhaps the same, has been found in the cavities hollowed out in stone by the pholades.

We have an annelide in Nova Scotia that hibernates in winter as represented, and is busy in our mussel beds in summer. I cannot say whether it is the species or not alluded to by M. Andrews. I have not heard of its being found in the cells of the teredo.

Experiments in the preservation of wood from the attacks of the Teredo.

The trials made by the Commission may be placed under three principal groups:

1. Coatings applied to the surface of wood, or modifications of the surface itself.

2. Impregnation of wood with different substances, which modify the interior as well as the surface of the wood.

3. Employment of exotic woods, other than ordinary woods of construction.

Coatings applied to the surface of wood. The methods belonging to this group; which have been examined by the Commission, are the following:

1. Method invented by M. Clawren, and kept secret by the inventor.

2. Metallic paint, invented by M. Clawren, and likewise kept secret.

3. Method of M. Brinkerink, consisting of a mixture of Russian talc, resin, sulphur, and finely powdered glass, applied hot

on wood previously roughened by a toothed instrument; this application was two millimetres thick.

4. Method of M. Ripurjk, analogous to the preceding.

5. Paraffine varnish, obtained by the dry distillation of peat, from the factory of M. M. Haages & Co., at Amsterdam.

6. Coal tar applied cold on the wood in several successive layers, or applied hot on wood whose surface had been previously carbonized. Some pieces were treated as follows: Holes were first bored in them and filled with tar; then plugs were fitted closely to the holes and driven in with sufficient force to make the tar penetrate the wood; other pieces still were painted over with a mixture of tar with sulphuric acid, or sal ammoniac, or turpentine, or linseed oil.

7. Painting with colours mixed with turpentine and linseed oil, among others, with chrome-green or with verdigris.

8. Singing or superficial carbonization of the wood.

The pieces of wood thus prepared were placed in the water at the end of May, 1859, and the first examination, made toward the end of September of the same year, showed that neither of these methods afforded any protection from destruction by the Teredo. There was one partial exception, and that was the piece of wood treated according to No. 6; these showed only traces of the Teredo here and there. But at a later examination, in the autumn of 1860, when the wood had been exposed a year and a half, these were also found to be equally severely attacked by the Teredo.

The results of these experiments strongly convinced the Commission that no exterior application of any nature whatever, or modification of the surface merely, would give any efficacious guarantee of protection against the teredo. Even supposing that one or another of these means would prevent the young teredo from attaching themselves to the wood, yet the constant friction of the water or ice, or any accident, might break the surface of the wood sufficient to give access to the teredo.

This seems a proper place to mention a practice in general use in Holland for warding off the teredo; this consists in covering wood with a coat of mail made of nails. This operation is very

costly; for, to really protect wood in this way, it is important that the square heads of the nails join exactly; for insuring the best results, the armoured piles are exposed in the open air for some time before being placed in the water, that rust, forming on the surface of the iron, may close up the interstices inevitably remaining between the heads of the nails. But this precaution is not infallible, as the Commission examined piles more than once, in the course of its investigation, which had been several years in the water, and whose surface was entirely incrusted with rust more than a centimetre thick, but which were, nevertheless, eaten in the interior by the teredo.

Impregnation of wood with different substances. The Commission examined in this category the following methods:

1. Sulphate of Copper.
2. Sulphate of Protoxide of Iron (Green vitriol).
3. Acetate of Lead.
4. Soluble Glass and Chloride of Calcium.
5. Oil of Parafine.
6. Oil of Creosote. This is, as is very well known, a product of the dry distillation of coal tar, separated by distillation from the more volatile parts, which serve for the preparation of benzole and naptha, the residuum being pitch. Experiments had already been tried abroad, as well as in Holland, with this substance, and from the beginning of their experiments the Commission paid especial attention to this very important method of preparation.

Wood of various kinds, prepared with creosote oil, at the works of the Society for the Preservation of Wood, at Amsterdam, was placed in the sea in the month of May, 1839, at Flessingue, Harlingin, and Stavoren, the pieces of oak, pine and red fir, were found intact, while those unprepared were perforated. In the month of October, of the same year, the pieces of creosoted pine and fir at Harlingin showed a perfect state of preservation. At Harlingin the treated and untreated pieces were fastened together; the teredo penetrated the latter, but had not touched the creosoted wood. The same was true of the creosoted wood at Stavoren, when visited in 1859.

At Nieuwendam in March, 1859, three pieces each of oak, pine, and red fir, all creosoted at Amsterdam, were exposed in the sea. They were examined in September of the same year. They had been fastened together by cross pieces of unprepared wood; it was found that the teredo had penetrated, at the juncture of these cross pieces, even into the creosoted wood, and that sometimes he stopped immediately beneath the surface; at others he penetrated to a depth of several millimetres; in the oak, he worked his way into the interior through those parts of the surface which were not in contact with the unprepared wood.

Experiments with creosote oil were recommended in July, 1860, with ten pieces each of oak and red fir, following the plan indicated in paragraph 5; the localities chosen were Kieuwe-Diep and Stavoren; in the latter place the pieces which remained intact the previous year were again placed in the water after their surface had been removed by the adze. Still later in August, 1861, a further trial was made at these same places, with pieces of pine, beech and poplar, sent to the Commission by Mr. Boulton, and prepared at his works in London. All these pieces were examined toward autumn in 1862, 1863 and 1864; while the unprepared pieces, placed near the others as counter-proof, were found each year filled with teredos, one could not discover any traces of the teredo in the creosoted pieces except in the oak creosoted at Amsterdam; in cutting these it was found that the creosote had penetrated them very imperfectly. A third examination in 1864, showed that all the pieces prepared by Mr. Boulton, and which had been exposed in the sea since August, 1861, were entirely intact; the most careful examination could not show the slightest trace of the worm, even in the pieces withdrawn from the water in 1862 and 1863, and each time scraped to a depth of several millimetres and again placed in the water. They resisted the attacks of the teredo perfectly.

Conclusions. By way of recapitulation, the result of the experiments, tried by the Commission during six consecutive years, were as follows:

1. The different coatings applied to the surface of wood, with the design of covering it with an envelope on which the young

teredo cannot attach itself, offer only an insufficient protection; these coverings are likely to be injured either by mechanical means, such as the action of the water, or by being dissolved by the water. Just so soon as a point of surface of the wood is uncovered, be it ever so small, the teredo, still microscopic, penetrates into the interior. Covering wood with sheets of copper or zinc, or with nails, is a too expensive process, and only protects the wood so long as they form an unbroken surface.

2. Impregnation with inorganic, soluble salts, generally considered poisonous to fish and animals, does not protect wood from the attacks of the teredo.

3. Although we do not know with any certainty if among exotic woods there may not be found these which will resist the teredo, we can affirm that hardness is not an obstacle which prevents the mollusc from perforating his galleries; the ravages observed in wood of guaiacum and mamberlak prove this.

4. The only means which can be regarded with great certainty as a true preservative against the injury to which wood is exposed from the teredo, is the oil of creosote; nevertheless, in employing this means care is necessary that the oil be of good quality, that the inpregnation be thorough, and that such woods be used as will absorb oil readily.

The conclusions arrived at by our Commission are confirmed by the experience of a large number of engineers in the Netherlands, and also in England, France and Belgium. M. Crepin, a celebrated Belgian engineer, expresses himself thus, in a Report on experiments tried at Ostend, under date of February 5, 1864:

"The result of our experiments now seems decisive, and we think we can draw from them this conclusion: that soft woods, well prepared with creosote, are protected from the attacks of the teredo, and are in a condition to assure a long duration. The whole matter, in our opinion, is reduced to a question of thorough impregnation with good creosote oils, and the use of such woods as are adapted to the purpose. It has been found that resinous woods are impregnated much better than other varieties."

Mr. Fourtier, a French engineer at Napoleon-Vendu, in a report dated March 3, 1864, makes a resumé of experiments con-

ducted by himself in the port of Sables d'Olonne, in the following words:

"These results fully confirm those established at Ostend, and it seems to us difficult to refuse to admit that the experiments at Ostend and Sables d'Olonne are decisive, and prove in an incontestable manner that the teredo will not attack wood properly creosoted."

"Under date of Haarlem, April 20, 1878, Prof. Von Baumhaur, writes to Edward R Andrews, of Boston: 'I have deferred answering your favor of the 22nd of February, until I had corresponded with the chief engineers of the Waterstaat as to the results obtained in their experience in the use of creosoted timber in all our marine works, in large quantities, and during some tens of years. They all unanimously agree that the teredo will not penetrate timber thoroughly impregnated with creosote; but that, to obtain the best results, the work must be thorough, as they had observed that the teredo had destroyed piles only superficially infected.'

"Fir, if the sap be first withdrawn in a vacum and then treated with hot oils under a heavy pressure, can be most thoroughly creosoted; but oak is more difficult. Still, I have often seen heavy oak piles where the creosote had entered into the very heart."

In a paper read by Mr. Burt, before the Institute of Civil Engineers, London, upon the nature and properties of timber, with a description of the methods then in use for its preservation, after reviewing John Howard Ryan's, Sir William Burnett's, and Payne's process, then in use, he proceeds to say:

"One hundred parts of coal tar contain, when submitted to distillation, 65 parts of pitch, 20 of essential oil (creosote), 10 of naptha, and 5 of ammonia. The oil produced from this distillation is the creosote of commerce, now so extensively used for preparing timber. The preservative properties of this material appear to be threefold.

First. It prevents the absorption of moisture in any form, or under any change of temperature.

"Secondly. It is noxious to animal and vegetable life; there-

by repelling the attacks of insects and preventing the propagation of fungi.

"Thirdly. It arrests the vegetation or living principle of the tree, after its separation from the root, which is one of the primary causes of dry rot, and other species of decay.

"The attention of the author of the paper referred to, was first called to this subject in 1841, in consequence of having practiced the process, to some extent, for Mr. John Braithwaite (M. Inst. C. E.), on the Eastern Counties Railway. The works, in that case, were of the most primitive and incomplete description; nevertheless they answered the purpose, and the sleepers, prepared at Heybridge, eleven years ago, are as sound and perfect as the day they were laid down, although they are of Scotch fir, and not of very good quality. Since that time, being extensively engaged in preparing timber, many improvements have been made in the machinery and apparatus, and in the method of preparation.

"Creosote is at present used for preparing timber, either under pressure in strong closed cylinders, or by placing the timbers in open tanks, and keeping the solution up to a temperature of 120° to 150° until the required quantity is absorbed. Creosote has the property of crystallizing when the temperature is below 35°, and it becomes a hard compact mass of salts. It was in consequence of this peculiarity, and the difficulty of using it in the winter season, that peat was resorted to; and was done in the first instance by making a common fire-place at one end of the reservoir, and running a flue under the bottom. This system was, however, exceedingly dangerous, because the oil came in contact with the heated iron plate, and the temperature could not be raised beyond 70° or 75°, or only just sufficient to enable the work to be continued conveniently during the cold weather. The experiment was then tried of allowing high pressure steam to blow into and upon the creosote in the reservoir; by this means the temperature was raised as high as was required, and it has continued to be used. Where a steam engine is used for working the pressure pumps, the waste steam can be employed to heat the creosote, by passing it through a coil of pipe laid in

the bottom of the reservoir. This mode of heating was first adopted at Mr. Bethell's works at Battersea, and it answers admirably.

"The cylinder now used in the ordinary process is similar to a steam engine boiler, 6 feet diameter, and from 20 feet to 50 feet long. Formerly the end or charging doors were made in a variety of ways, some to open inwards, some to slide in air-tight grooves, and others similar to the cover of a gas retort. Nothing, however, answers so well as to have the cover of the full size of the cylinder, with proper fastenings, and all the joints accurately turned and fitted together, for the pressure on so large an area is enormous, and the heated oil is so exceedingly subtle, that great care is necessary to prevent leakage. Small trucks run on rails inside the cylinder and carry the load. These formerly ran out upon a long switch, and were then turned into a siding and unloaded. A different plan is now adopted, by making the inside lorries run out upon another larger and stronger truck of the ordinary gauge, so that by this means they can be run on to any of the adjacent sidings, to be unloaded without shifting a second time.

Since 1853 the process then described by Mr. Burt, as creosoting under pressure in strong cylinders, has become the favorite one to adopt to resist the attacks of the teredo. The same process, with slight modifications, is carried out to this day, both in Europe and America.

The Dutch Commission speak most favorably of it.

English engineers, such as Hawkshaw, Burnett, and others, speak of it from time to time in the Reports of the Transactions of the Society of Civil Engineers, in a very favorable manner. American engineers generally recommend its adoption.

But no better example could be desired of the efficiency of creosote to prevent the attacks of the teredo, than we have in the Harbor of Sydney, Nova Scotia. Here the teredo is seemingly as destructive, if not more so, than at any place on our coast, and here, about ten years ago, a coal-loading pier was erected sufficiently large that three ocean-going steamers could load coals at the same time. The pier runs out into the harbor ; it was erect-

ed entirely of pine timber, creosoted in Great Britain, and sent out here. It has most effectively withstood the ravages of the teredo, whilst all other piles in the neighborhood had to be renewed twice.

Not satisfied with reports about its permanency, so far, I requested that the Sydney and Louisburg Coal and Railway Company would have an examination made for the purpose of this paper. I have to-day a telegram from Mr. D. J. Kennelly, Q. C., managing director of that Company, in which he says: "Creosoted pier absolutely sound; ten years erected. Timber not creosoted twice renewed."

One of the objects of this paper is, firstly, to point out the necessity which exists for a creosoting apparatus to be placed in Nova Scotia, somewhere in the region of the Teredo's most active operations; and, secondly, that experiments be conducted by some responsible parties, as to the best means to adopt to arrest the ravages of the Limnoria Lignorum.

Considering the interests at stake and the great annual loss to the Department of Public Works, Canada, from these destructive animals, one would think that something should be done in the public interests, by at least investigating the matter, and with the view of proper remedial measures being taken so far as practicably possible, to mitigate or prevent their ravages in the future.

Art. VII.—Shore Birds of Nova Scotia. By Bernard Gilpin, A. B., M. D., M. R. C. S.

(Read April 10th, 1882.)

In studying the immense flocks of what are called Shore Birds, which yearly appear during July, August and September of each year upon the flats of the Bay of Fundy, St. Mary's Bay, the Tuskets, and Digby Basin, in Nova Scotia, we must consider them as migratory birds, breeding, with few exceptions, in the Polar regions, and now returning with their young to warmer latitudes, reaching even the Gulf of Mexico, and thus passing our

shores. They are generally in imperfect moult, having lost their nuptial plumage, which is not yet replaced by their winter one. Few full plumaged males appear, but females, imperfect males and young. Hence the difficulty of classing them. The pursuit of food alone urges them on their migration southward, whilst that of reproduction swept them onward in the spring to the fierce North. The spring route is more direct, more inland, and more quick. We see nothing of them during spring. The most obvious, and those which from numbers and from sight most modify our landscape, are the sand peeps (sand pipers, tringa), and next them the ring necks (the plover). These two speck the feathery margins of our salt-estuaries, whitening our flats and flashing like silver clouds in the air. Next in number come the larger plover, golden plover and beetle heads, which migrate in sufficient numbers to modify our landscape. The other species must be looked for by the naturalist, and from their numbers are scarcely noticed, save by the sportsman, or naturalist, and yet in their aggregate great numbers pass us. I have thought the members of the Institute would be interested in a description and classification of all these birds, the numerous as well as the more rare, and therefore in this paper shall give only what I have seen personally myself, of all the various shore birds that pass our shores during the autumn. I do not doubt that some have evaded my notice, or that I have found a difficulty in classification in others, yet the work of an eye-witness is always valuable. I shall use the Smithsonian nomenclature (Dr. Coues), thinking it the best, but finding some difficulty even in it, to say nothing of Nuttal, Wilson, and the older naturalists, in properly arranging all my species. Of the vast flocks which, as I said before, modify our landscape, I have found from a study of years, from minute measurements and accurate coloured drawings, that they are composed of two species of ring neck plover, and three distinct of sand peeps, or sand pipers, all in common in huge flocks.

The ring necks are the American ringed plover, Æ semipalmatus, and Æ melodus, piping plover. Of the sand peeps, with the utmost study, I have only found three species, the less sand

piper (Tringa minutela), the greater sand piper (Tringa Bairdii), and the semipalmated sand piper, E pusillus. It is with the greatest doubt I make this classification, as I think Tringa Bairdii too recent a nomenclature for a bird so well known. In Nuttall's work, so singular for its truth, he marks the Stint, a bird that I have never seen here or any sand peeps with any lateral tail feathers white. Besides in his descriptions and measurements he confounds at least four species. I shall minutely describe the two species of the Ring plover as I find them here, only saying that they as well as the sand peeps were selected from a heap of dead, brought in from shooting, and containing all five species of Ring plover and sand peeps in one stiffened mass.

Common Ring Plover shot at Digby, N. S., August 12, 1876:

Length, $7\frac{1}{6}$ inches.
Wing to wing, 15 inches
Bill, $\frac{5}{8}$ inch.
Tarsus, 1 inch.
Toes, $\frac{7}{8}$ inch.

The bill was high at base, nostrils basal black at tip, dull orange at base, legs and toes dull orange, nails black, joints pencilled black, no hind toe, toes joined at base with webs, outer web nearly double the inner. In colour, forehead, chin, neck running behind the head, all below and inside the wing, white. Above head, hind head, back, shoulders and wing coverts, olive brown. The forehead is black, holding within it a white spot, and running beneath the eye to the lores. A deep black collar, nearly an inch broad and running insensibly at the back into brown, surrounds the neck. Tail, when closed, black, sides of rump lightest; tail of twelve feathers. Outside feather white outer edge, more or less white on tips of four outside feathers, middle feathers black at ends; primaries, secondaries, and tertiaries more or less dark with white shafts, coverts tipped obscurely with white. Some specimens had scarlet rings around the eyes, some not. The olive brown colour and the semipalmated and orange foot, determine their species very easily, as the semipalmated plover of Wilson, and the Ægialites semipalmatus of Coues. Another Ring neck shot in August, 1876, differed from these in

colour of body, size and colour of legs, and not having semi-palmated feet. In colour it was white below, and pale bluish ash above, with no brown or olive tint. The signs of black or of ring about the neck were very slight, and light dusky. The middle tail feathers were black, tipped white at the end, and there was a white stripe through primaries, secondaries and tertiaries. The bill and feet black and shorter than in the true ring plover, and the whole bird smaller. On searching for these birds I found they went by themselves, were scarcer, and hard to get. I have classed them, with some doubts, with the charadius melodus of Nuttall and Wilson, and Ægialitis melodus, Coues, thinking the difference of leg, bill and colour were from imperfect or young birds. We may generally conclude that the semi-palmated variety is very common, and individually found in brightest colour of olive brown, yellow feet and red ring about the eye; that he always assorts with the peeps; is found at high water, emarginating the shores, waiting for the ebb to bare the flats, over which he spreads himself; and that he appears sparingly in July, numerously in August, and leaves in September. Of the second species you think them plenty; but searching for them, you find them scarce—though found in company with the peeps. All these birds have doubtless lived at the north, and are passing our shores with their females and young. As I saw a few breeding on Sable Island with the peeps and terns, though not determining their species, I think that increasing population, and not choice, may send them so far north. All due allowance must be made for imperfect moult and young birds.

After writing a description of these Fall birds I have had an opportunity of examining three specimens of this plover, Egialitis melodus (Coues), shot April 24th, 1882, at Digby, N. S., and in full nuptial plumage. Mr. Downs also has a group of the adult birds and young, shot near Halifax, proving that it breeds with us, though the greater numbers that appear in Fall must prove it also to be migratory.

Extreme length, 6 6-10 inch.
Wing spread, 14 inch.
Length of bill, ½ inch.
Length of tarsus, 7-10 inch.

Colour of bill yellow, with black tip; toes and legs yellow, but palms and toes slightly pencilled dark, yellow ring about the eye. Head, back, wing coverts and rumps ashey grey, but coverts with slight black shading, each feather with a white edge. Forehead white, with a black band above, a black collar going round the back, but more or less incomplete in front. The cheeks whitish with ashey wash, showing small black spots beneath and behind eye. In one specimen the black collar was entire around the throat; chin, hind neck, breast, belly and all below white. Sides of rump white, middle tail feathers black with light tips; lateral tail feathers white, 2nd lateral tail feathers white, 3d inner white, with a black spot in it, the other lateral ones having black bands on the extremities, but near the body white. Shaft of the primaries and secondaries white. The primaries black upon the outer van, but having a white streak running through them and the secondaries, and joining the lower edges of the greater wing coverts and tertiaries. The tips of primaries and secondaries were black, the wings not reaching the end of tail in dead bird. The eye was black with yellow ring. No hind toe, inner toe cleft to base, scarcely a web between outer and middle toes. This is the nuptial plumage of the piping plover, differing sharply in colour, and not having semi-palmated feet, from the semi-palmated species, and agreeing with the imperfect Fall birds. I have not noticed Wilson's plover in Nova Scotia.

Of the sand peeps I have been able after years of study, measurement and coloured drawings, to determine but three species. It will better serve the interests of truth for me to describe these species from my own note book, rather than attempt a classification with the older or more modern naturalist. Those who are willing to wade through my paper will, I am certain, have a true history of the Nova Scotian Species.

Small Sand Peep, Aug. 23, 1876, Digby:

Extreme length, $5\frac{3}{8}$ inches.
From wing to wing, $11\frac{5}{8}$ inches.
Length of bill, 6-8 inch.
Length of tarsus and toes, $1\frac{5}{8}$ inch.

Toes not connected by membrane at base, hind toe small; legs

pale greenish-yellow. General colour, head, neck, back and coverts dark sepia, the edges of each feather margined with a lighter or rufus brown. The rump sooty-black, reaching to end of closed tail, which is margined with rufus. Primaries, secondaries and tertiaries blackish, edges light, which, with white shafts, gives the appearance of a faint white line down each feather. Wing coverts edged with white; faint dark line from mouth through the eye; a broad faintish-brown collar about the breast; beneath, to end of tail, white; bill blackish.

Another shot 20th September, 1880, at Digby, gives—

Length, $6\frac{1}{4}$ inches.
Length of bill, $\frac{3}{4}$ inch.
Of tarsus, $\frac{3}{4}$ inch.
Wings spread, $11\frac{1}{2}$ inches.

Colour: forehead, neck, back of neck, shoulders black, more or less, but each feather with an edging of light ferruginous, on neck and head less, but greater upon shoulders, wing coverts and tertiaries, the whole effect being black spots with a decided ferruginous wash. The rump and middle tail feathers black, a little white showing on either side of rump; the edging of tail feathers ferruginous, the side tail feathers lighter than middle ones. Chin, and obscurely above eye, whitish, a very obscure dusky line from bill to eye; neck to breast grey, pencilled black, forming distinct colour. Below white to vent. The outside shaft in the first primaries white.

A Sand Peep shot at same time, 20th September, 1881, measured:—

Length, $8\frac{3}{4}$ inches.
Length of tarsus, 15-16 inch.
Length of bill, 1 inch.
Stretch of wing, $16\frac{1}{8}$ inches.

Though the greater size showed directly a different species, yet I could find no difference in colour betwixt these than that the wing coverts above the secondaries in the smaller were more broadly edged with white. The bills in both were alike and black nostrils basal, upper mandible with a sulcus running half way to tip. Legs and feet in both dark brownish, four-toed and

palmated; hind toe slight and inserted above the palm. In their figures coloured they resemble each other in the well stained neck and front, absence of ash and hoariness, and presence of ferruginous tints. Thus I must conclude that I have two species akin in all but size, one ranging from five to five and a half inches, the other from seven and one-half to eight inches, both four-toed and without webs. Richardson, under the species pusilla, may mean the last one as well as Wilson, by the size.

But amongst these flocks I found a third sand peep, which was not only semi-palmated, but different in colour from the others.

Shot 5th Sept., 1881. Bay of Fundy:—

Length, 6 inches.

Spread of wing, $11\frac{1}{4}$ inches.

Length of tarsus, nearly 1 inch.

Length of bill, $3\frac{1}{4}$ inches.

Colour on back and top of head, shoulders and wing coverts greyish, interspersed with black streaks and spots, spots more on back and shoulders; rump black, tail greyish, the upper and lower tail coverts nearly as long as the tail. A small white streak behind the eye, and spotted line of dusky from bill to eye; throat and all beneath white, bill black, legs black with olive wash; toes palmated, inner web smaller than outer. In comparing this species with those shot 20th Sept., and nearly of the same dimensions, but not semi-palmated, we find no ferruginous tints, rump not so black, breast whiter, and with very slightly marked collar, colour of legs more olive. In this specimen the shafts of both primaries and secondaries are white, also the tips of the wing coverts. But upon the nonsemi-palmated, both greater and less, we find the white bar upon the wing, broader, and formed not only by the wing coverts, but also the primaries and secondaries, as it was joined in the white mark. This bird has come down to us "semi-palmatus," from Hutchins, Wilson, Richardson, Nuttall, and Buonaparte; yet Coues gives it as pusillas, without giving his reasons. It certainly is the only semi-palmatus I have found frequenting the Nova Scotia shores in a study of years; is very well marked, which shows more when the coloured drawings of each are opposed to each other.

The next birds which may be said from their numbers to modify our landscape are the plover, the green or golden plover, and the larger beetle heads. They usually migrate together, and are seen with us from August and September, a few lingering till November. Heavy south-west gales confuse them, and mass them in numbers as they prepare to light, during the gale, in the fields and on the shores. The large kind rather affect the fields, the smaller kind the shores. It is very seldom you meet a male in full plumage, or black breast and belly. Their usual colour is spotted greenish on the back, with black splotched beneath. Coues denies the greenish or yellow wash upon the larger species, but my note, Sept. 20th, 1881, gives this yellow wash upon their backs. I have also observed a black spot beneath the wing, near the shoulder, as typical of the larger species. The fourth toe, or nail, in the larger, wanting in the smaller, is the best mark to determine the young from each other as they approach each in colour and size. A very handsome male in full nuptial plumage, with deep black breast and vent, may be seen in the Halifax Museum, of the larger species. Though in the thousands which annually pass us during the autumn, I never have found one.

Of the various other birds of this family that pass us in numbers, there are so few that the sportsman or naturalist only observes them. We may notice the Sanderling whose appearance at Digby I note during September, in his usual grey dress. The Killdeer very rare, having a single notice of him during March, at Halifax. The Turnstone cosmopolites, appearing everywhere, are seen at Digby during September. The Avoset I saw at St. John, killed there, and in Mr. Carnal's collection. The three different kinds of Curlew I have determined. The larger great billed Curlew seen by myself Sept., 1870, at Windsor, N. S.; the Esquimau Curlew, and the smaller Esquimau Curlew, distinguished from the last by its size, and not having the wings beneath barred as in the last.

My notes give September for all these species. The cape Curlew I have noted Halifax, October. Tringa subarquata, Schinss sand piper, I note Halifax, Oct., 1864, but I am not cer-

tain. The pectoral sand piper Sept., 1865, Halifax, and afterwards at Digby. The buff breasted sand piper I note Provincial Museum, Halifax, and the purple sand piper at Halifax. The knot or ash coloured sand piper, Sept., 1880 and 1881, in winter plumage. The semi-palmated Snipe or Willet, Digby, June, 1877. Both species of the yellow shanks, the larger and the lesser, are both common in September. Of the tattlers, the solitary or green rump tattler is common; barn snipe as it is called from its solitary haunts about barn pools, and the spotted tattler, is common everywhere. Of Bartram's tattler, or the grass plover, I note one specimen, and that from Sable Island, 1868. This brings us to the Godwits, both species of which, Marbled and Hudsonian, I have noted, the Hudsonian shot, in August. The brown or red breasted snipe is the last autumn visitor I will mention as noted in September.

I have never met with the Dunlin or Ox bird in Nova Scotia, nor do I mention the Phaloropes, though I have seen them and think we have two species, certainly the rose colored one, but am not able to identify them. Wilson's snipe and the Woodcock are common residents, breeding here, the latter plenty, though it requires a good dog, gun, and quick shot to find them. I have seen a bag of twelve or thirteen couple made by my son in a few hours, besides grouse and hares, when he combined all these attributes at one time. A wounded woodcock that I kept by me was lively at night, and always kept its tail spread and crested like a fan over its back. In this paper I have given only my own personal observations of what was seen in Nova Scotia. No doubt many species of North American birds do not pass our shores. In endeavouring to clear the vexed story of the peeps or sand pipers I have thought it best to describe the only three well marked species that I have noticed; and to say that however numerous or varied other North American species may be, I have not found them here. To attempt to class our species here with those of Wilson, Nuttall, or Richardson, is to immediately fall into a crowd of stints, pigmies, lesser pusilla, minor sand peeps, all of which seem to have the same measurement and colouring. Amongst these the semi-palmata seems to stand out boldly

in different colour and semi-palmated feet; yet Coues returns this bird under the name of pusilla to the old group, and without giving his reasons, which no doubt are good, if known, but unknown cannot stand before Hutchens, Nuttall, Richardson, Wilson and Buonaparte. In his key of North American birds had he put the first discoverer's name to the specific, as he has done to the generic name, it would have added much to the value of a very useful work. Naturalists owe him much for sweeping away the too numerous genera in the gulls and penguin ducks as Darwin calls them. I mean the very restricted genus of Scoter so like in colour, bills and habits.

List classed after Dr. Coues.

Squartolinas helvitica—Beetle head.
Chavadius fulvus—Golden plover.
Ægialitis vociferus—Kildeer.
Ægialitis semi-palmatus—Ring neck.
Ægialitis melodus—Piping plover.
Strepsilus interpres—Turnstone.
Recurvirostra Americana Avoset.
Machtoramphus griseus—Red breasted snipe.
Ereunictes pusillus—Semi-palmated peep.
Tringa minutella—Least peep.
Tringa bairdis—Baird's peep.
Tringa maculata—Pectoral sand piper.
Tringa maritina—Purple sand piper.
Tringa subarquata—Curlew sand piper.
Calidris arenaria—Sanderling.
Limosa fedora—Marbled godwit.
Limosa Hudsonia—Hudson Bay godwit.
Totanus semi-palmatus—Willet.
Totanus melanolcucus—Great yellow shank.
Totanus chloropus—Lesser yellow leg.
Totanus solitarius—Solitary tattler.
Tringoides maculata—Spotted tattler.
Actiturus bartremius—Bartram's tattler.
Tryngites rufessens—Red breasted sand piper.
Numenius longirostres—Long billed curlew.

Numenius Hudsonius—Hudson's curlew.

Numenius borealis—Esquimaux curlew.

I have not mentioned in this list Schinze's sand piper, although my notes give him at Halifax, August, 1864. I have no distinct recollection of the bird, or of seeing Dunlin's, an enlarged copy of it, in Nova Scotia. It is very rare here or not a true species. I think there is Dunlin immature bird in the Halifax Museum. Of all the shore birds that grace our landscape, as I have before said, the peeps are the most pleasing. The great Bay of Fundy tide that has rushed in almost cataract force through the oppossing traps in the gut, now expanded in the Basin fills to the utmost brim with a power though unseen yet quite as great, every rushy estuary, and every silver sand flat of the great basin. All is steeped in one bright glancing and quivering calm. The peeps are lining the edges of the flats waiting for the ebb. The great herons have come from their heronry twenty or thirty miles on the borders of a tangled spruce lake, waiting for what the ebb may leave them. The barking, and rising and falling of the crows, and squeaking of the herons from their roosts on the overhanging trees tells that the hawk (F. Columbarius), like a privateer, is backing and filling and waiting his ebb, too near them. These sights and sounds come down upon you as the first soft ebb floats your canoe down the bay. If you are out pot shooting, the noiseless current floats you down towards the flats, now rapidly showing out of water, and covered by thousands innumerable of creeping forms. The whole host, scared by your approaching canoe, with a sharp whistle rise, stretch landward a few rods, then rise in the air and open into a white sparkling cloud, reflecting the bright sunbeams. Now is your time; both barrels of your breech loader, and the mitraille of mustard seed shot cover the water around with the dead and dying. To slowly pick up the dead and secure the living you turn homewards. From twenty-five to thirty birds, ring necks and plover of several species, are enough to vex your cook and serve for a pot-pie. But if you are out for a pic-nic, and stowed beneath the bear robes, on the very bottom of your canoe, are your wife and little ones, and camp kettles and tea, bread, milk and sugar, and

the charming July sun tempts you, you give way for the mouth of the basin, where the huge boulders of traps stem the Bay of Fundy tides, heaping great sand beaches at their bases. Your canoe grits upon Indian beach, you run it up amidst dozens of other Indian canoes, and scan half way up the rocky barrier a shady spot for your bivouac. Here your Indian builds his fire, two parallel lines of stones eighteen inches high, with a trench between, picks and cleans his birds, and cutting branches from the nearest tree, impales a bird on every twig, resting the whole branch over his fire. Gravely he hands to each guest a branch with its roasted fruit, who, holding the branch in one hand pulls with the other the birds from the twigs. To one who has eaten of this Abyssinian banquet there is no need to tell of their tenderness and juicy delicacy. The rigor mortis has not yet stiffened the dead birds. This comes on after a few hours and then passes off after a day or two. If you cook the grouse shot upon your tramp for your night's supper, you are surprised how tough they are, but if you hang them in your camp for a day or two you find them tender. The Indian, like the Abyssinian, chooses the almost living flesh for his feast.

ARTICLE IX.—"THE NORTHERN OUTCROP OF THE CUMBERLAND COAL FIELD." BY EDWIN GILPIN, A. M., F. G. S., F. R. S. C., ETC.

(Read May 8th, 1882.)

MY object this evening is to lay before you a brief summary of the work which has been done on the northern outcrops of the seams of the Cumberland Coal Field. Some of the information is new and of importance, but for much of the work done at an early date I have had recourse to official sources.

The Cumberland coal field was for many years an unknown and unpromising district. It was accessible by water at the Joggins only, to allow competition with the coals of Sydney and Pictou. The presence of coal seams was known at several other points, but the want of any means of transportation forbade an attempt to open them.

Under the influence of a temporary demand for coal in the United States, several mines were opened between Maccan and the Joggins; but they were abandoned as soon as the necessity ceased that called them into operation.

When, however, the long dreamt of Intercolonial Railway was opened through the centre of the field, a fresh and more lasting impetus was given to the coal trade. A large and flourishing mine was opened at Springhill, through the energy of some merchants of St. John, who have been well rewarded for their enterprise in taking hold of a property which was rejected by the people of Halifax. The demand for fuel at the Londonderry iron works has led to the opening of another colliery, and other properties are being prepared to meet the revival of business in the mineral we are now considering.

In view of this encouraging state of affairs, it may not prove uninteresting to you to learn not only what progress in development has been already effected, but to consider what additional stores of mineral wealth may be contained in the district treated of in this paper.

The key to the general structure of the Cumberland coal field is found at the Joggins, presented in a beautiful and unbroken section of the various divisions of the carboniferous system. This has been carefully studied and minutely described by Dr. Dawson and the late Sir Charles Lyell, and I shall refer to it so far as may be necessary to show its bearing on the distribution of the productive measures over a district 25 miles in length. On referring to Dawson's "Acadian Geology," we will find the Joggins' coal-measures bounded above (geologically speaking) by a set of massive sandstones (the upper coal measures), and below by a series of sandstones, grits and conglomerates (the Millstone grit). These massive covers, like the pasteboard of the book-binder's art, serve not to hide, but to preserve the material contained between them. The following summary, in descending order, will show the relative thickness of these great layers of sediments:

UPPER COAL MEASURES.

Upper part	650 feet.	
Lower "	1607 "	
		2267 feet.

PRODUCTIVE COAL MEASURES.

Upper part	2134 feet.	
Lower "	2623 "	
	——	4757 feet.

MILLSTONE GRIT.

Upper part	2000 feet.	
Middle "	3240 "	
Lower "	640 "	
	——	5880 feet.

The lower part of the Upper Coal Measures is exposed at Ragged Reef, where it is made up chiefly of hard and massive gray and white sandstones, with occasional beds of a reddish colour, and red and gray shales.

The upper part of the Productive Coal Measures comprises about 1000 feet of gray sandstone, and nearly the same thickness of gray and reddish shale and fire clays. It contains 22 coal beds, all of which are thin and of poor quality as exposed on the shore, and will not be again referred to in this paper.

The lower part of the Productive Measures, holding all the workable seams yet known on the shores, is characterised by gray sandstones, and gray and dark coloured shales.

The Millstone Grit series forms an abrupt change in appearance to the measures holding the coal beds. It consists of reddish shales and red and gray sandstones, the latter passing into fine grits and conglomerates. It is, moreover, destitute of coal, and shows very few fossils beyond a few drifted pieces of wood.

The following section of the lower part of the Productive Measures shows the principal coal beds and their relative positions:—

	Feet.	*In.*	*Feet.*	*In.*
Strata	339	7	—	—
Main Seam	——	—	7	7
Strata	75	0	—	—
Queen Seam	——	—	4	10
Strata	968	0	—	—
Coal bed	——	—	4	0
Strata	18	—	—	—
New Mine Seam	——	—	3	0
Strata	1160	—	—	—

Only two of the above seams, namely, the main and new mine, are considered workable at the Joggins. We therefore have this vast thickness of strata, comprising 4757 feet, yielding in its upper half no seams worth mentioning, and in its lower part only four beds meriting the miner's attention..

In considering this great mass of sediments, with its alternating layers of coal, clay, sandstones and limestones, it must be borne in mind that the various changes chronicled at the Joggins did not necessarily extend over the whole of the Cumberland coal field. But, as Dr. Dawson remarks, had we visited the district during the coal period, we might, by changing our position a few miles, have passed from a sandy shore to a peaty swamp, or the margin of a lagoon. The evidence of similar districts at the present day, and the sections of their coal fields, show that, although these changes would be visible in passing over the ground, still the horizons of deposition, whether of vegetable matter or of sandstone, etc., vary very little, and that the persistence and regularity of the coal beds is greater than that of the associated measures. We thus find in Cape Breton coal seams preserving over considerable areas a uniform size and relative position while marked variations are observed in the thickness of the containing beds. Had we visited the district we are considering at a period coinciding with the formation of one of the coaly beds, we would have seen on all sides vast swampy plains covered with dense forests of strange shapes and unknown hues; calamite brakes and peaty bogs, traversed by sluggish streams and shallow lagoons, impeded and changed in their course by the luxuriant and encroaching vegetation. Again, a visit at the time of deposition of some of the great beds of barren sandstones would have shown us a wide and shallow sea filled with sandbars and low islands, on which grew straggling calamites, fighting for an existence amid the shifting sands.

We may now briefly pass in review the sections of the seams presented at the various mines which have been opened on the eastern extension of these strata.

Near the shore the Joggins main seam presents the following section recently measured by myself:—

	Feet.	In.
Coal	2	10
Coal and shale (holing)	0	5
Shale	2	6
Coal	1	10
Total	7	7

At the face of the most easterly workings, the parting has diminished to 4 inches.

The New Mine seam presents the following section:

	Feet.	In.
Coal	1	4
Coal and shale	0	4
Coal	1	1
Fireclay	0	4
Coal	0	3
Total	3	4

At the Victoria Colliery, a section is presented which does not agree with any seen on the shore three miles distant, viz :—

		Feet.	In.	Feet.	In.
No. 1 Coal				1	10
Strata				15	0
No. 2 Coal				3	0
Strata				50	0
No. 3 Coal	Coal	0	6	5	2
	Shale	1	4		
	Coal	1	2		
	Shale	0	10		
	Coal	1	4		

A mine is being opened by the Minudie Coal Company, on a seam underlying those worked at the Victoria Colliery by about 900 feet. This seam presents the following section:—

	Feet.	In.
Coal	1	8
Shale	0	10
Coal	1	10
Total	4	4

This seam is apparently the same as that shown in the preceding section, intervening between the Queen and New Mine seams.

At the next colliery, the Lawrence, there are two seams, each 2 feet 6 inches thick, separated by 20 feet of strata.

At the Maccan Colliery there are three seams, presenting the following section:—

		Feet.	In.	Feet.	In.
No. 1 Seam	Coal, coarse..	0	8	2	4
	Coal, good....	1	8		
Strata				100	0
No. 2 Seam				1	8
Strata				300	0
		Feet.	In.		
No. 3 Seam	Coal, good...	0	2	4	0
	Shale, " ...	0	4		
	Coal, " ...	0	10		
	Shale, " ...	1	6		
	Coal, " ...	1	2		

At the Scotia mine two seams have been worked. The upper one is 2 feet 9 inches thick. The lower one, separated from the other at the slope by 10 feet of rock, presents the following section:—

	Ft.	In.
Coal (impure)	1	3
Coal	0	11
Shale	0	$4\frac{1}{2}$
Coal	1	5
Shale	0	$1\frac{1}{2}$
Coal	0	11
Total	5	0

This parting of ten feet rapidly diminishes to the eastward, and the seams unite on the Chignecto area.

At the Chignecto mine, now being opened by the Steel Company of Canada, the same seam presents the following section:—

	Ft.	In.
Coal	1	0
Shale	0	2
Coal	1	0
Shale	0	1
Coal	0	6
Shale	0	1
Coal	0	3

Shale	1	0
Coal	1	3
Shale	0	3
Coal	2	1
Shale	0	3
Coal	1	2
Total	9	3

At the St. George mine the same seam presents a somewhat similar section, viz:—

	Ft.	In.
Coal (several thin partings)	3	6
Shale	2	0
Coal	0	3
Shale	0	$1\frac{1}{2}$
Coal	1	3
Shale	0	2
Coal	1	9
Shale	1	10
Coal	0	11
Total	11	$9\frac{1}{2}$

At the Styles' mine the following section of seams has been proved in ascending order, and is from information given me by Mr. James Hickman:—

		Ft.	In.		
1st Seam				2	0
Strata				12	0
2nd Seam	Coal	1	10	3	6
	Shale	0	6		
	Coal	1	2		
Strata				18	0
3rd Seam	Coal	3	6	6	0
	Shale	0	10		
	Coal	1	8		
Strata				30	0
4th Seam	Coal	2	0	3	6
	Shale		8		
	Coal		10		
Strata				8	0
5th Seam				1	10

This section represents the seams extending from the Styles

Brook to the St. George mine, a district about five miles in length. This end of the coal field will, from its proximity to the railway, and the regularity of the strata, prove an important future source of coal.

These sections differ widely, and in addition to this there are numerous faults known on the River Herbert areas. A heavy fault is also reported on the west line of the Styles area. We thus find that the seams cannot with any show of reason be correlated with either of the coal-beds worked at the Joggins, so far as their sections are concerned, and the presence of heavy faults prevents a satisfactory comparison between those of areas separated by a short distance.

Dr. Dawson considers the seams at the Victoria Colliery (already referred to) as representing the New Mine seam, the coal bed (given in the section) lying eighteen feet above it, and another coal bed 35 feet below it, containing three feet of coal and shale as represented in the Joggins section. He also compares the Chignecto seam with the bed lying eighteen feet above the New Mine seam, and he further suggests that the equivalent of the main seam is yet to be found in the eastern part of the district.

The work of the Geological survey has brought out new facts, which support his opinion as to the probable position of the Joggins main seam, while they oppose his correlation of the seams already given.

On approaching the Styles mine from the north a band of fine grained conglomerate is met, composed largely of syenitic, quartzite, and slate pebbles, the whole having a greenish and red colour. The thickness of this conglomerate and some associated beds of red shale is about 1,500 feet, and it is underlaid by about 1,000 feet of chocolate coloured shales and sandstones.

This bed of conglomerate has been traced from a point several miles east of the Styles mine nearly to the Maccan River, and throughout this distance it preserves the same characteristics, and appears to form the summit of the Millstone Grit. There is also, as mentioned by Mr. McOuat, another point supporting this view, that is, the underlying chocolate coloured shales are seldom

exposed, and have been eroded into a depression to the north of the conglomerate, recalling the great mass of soft strata lying between the upper part of the Millstone Grit and that section of it which furnishes the Joggins grindstones.

The Styles, St. George, Chignecto and Scotia seams all occur at a vertical distance above this conglomerate of 450 to 500 feet. We thus find ourselves provided with a clue at each end of this coal field, and the conclusions to be drawn from the facts I have endeavoured to give you in the briefest possible manner, are of considerable importance in their bearing on the coal values of the district.

On referring to the section of the Productive Measures, it will be noticed that the New Mine seam, which Dr. Dawson considered on the same horizon as the Victoria and Chignecto seams, is 1,100 feet above the Millstone grit. The equivalents, therefore, of the seams found at the Styles and other eastern mines must be sought for in the Joggin section, half way between the New Mine seam and the Millstone Grit.

There is a coal bed found at the Joggins 520 feet above the Millstone Grit, presenting the following section, viz :—

	Ft.	*In.*
Coal	0	4
Shale	1	6
Coal	0	6
Shale	1	3
Coal	0	1
Total	3	8

This may, so far as our data extend, be considered the equivalent of the eastern seams. It would then appear, that, if the conditions necessary for the formation of coal beds were as favourable in the eastern part of the district as they were at the Joggins, workable coal beds would be expected to exist on the horizons of the New Mine and main seams, respectively 1180 and 2289 feet above the Millstone Grit. Judging from the thickness of the seams known in the district east of the Maccan River, these conditions have been more favorable than at the Joggins; and there would, as the thickness of the measures and their characteristics

remain practically unaltered, be reasonable ground for expecting to find the different seams better adapted for the miner's work than at the Joggins.

I have already spoken of the Ragged Reef sandstones forming the upper cover of the Productive Measures. This sandstone, occurring in massive beds, overlaid by red and gray shales and sandstones, has been traced into the eastern district. From the report of Mr. McOuat, already quoted, it appears that it crosses the Maccan River below Athol, and strikes the Little Forks River about a mile below the Styles Brook, and follows the course of the river to a point about a mile beyond the post road.

The vertical thickness of Productive Measures between the base of this sandstone and the Millstone Grit is, at the Joggins, 4757 feet; at the Styles Brook, 4500 feet, equivalent at the latter place to an interval of about a mile, measured horizontally. From the course of the conglomerate, which turns to the south about three miles beyond the Styles mine, it would at no great distance run under the sandstone. This is accounted for by the officers of the Survey on the supposition of a great fault, an upthrow to the east, probably of several thousand feet. There are other methods by which this apparent obliteration of the Productive Measures can be explained, but the discussion would make this paper too long.

This district affords a capital illustration of the principle that Nature never yields her secrets to the efforts of individuals confined to limited districts. Explorations had been carried on for years in ignorance of the fact that to the north of the Productive Measures the line of the Millstone Grit had been drawn clearly and distinctly; and that to the south an equally distinct barrier defined the area in which the prospector would legitimately exercise his skill and perseverance.

The work of the Geological Survey in this coal field, for some unexplained reason, was left incomplete, but so far as it has been carried in the Northern district, useful hints have been given to the prospector, which I have endeavored to place plainly before you.

We have seen that at the Joggins, the workable seams and the

most promising coal beds are confined to the lower part of the Productive Measures; while the upper half lying immediately below the Ragged Reef sandstones appears to be worthless. So far as I am aware, this set of rocks has not been systematically explored, and its coal contents east of the Joggins are problematical. However, as we have seen that the coal values of a certain horizon in the lower portion have improved to the east, we may anticipate that it is quite within the bounds of possibilities that conditions favorable to the accumulation of workable seams of coal have occurred through this long stretch of coal measures.

Having thus briefly discussed the known seams, and the possible future greatly enhanced value of the district, it remains for me to draw attention to the qualities and transportation facilities of the seams already noticed, with the proviso that any seams found in the future will be more favourably situated for outlet than those now proved.

The distance from the Intercolonial Railway to the furthest east point yet proved in the district is 3 miles. This distance gradually diminishes until the Railway enters the productive belt, and traverses it for a distance of about 1½ mile. By this road a ready outlet is furnished to shipping at Dorchester, 29 miles from Maccan.

The Maccan and Herbert Rivers furnish good shipping facilities for vessels up to 300 tons burden, and at the Joggins coal is loaded into vessels directly from the mines.

I regret to say that at the time I prepared for the Newcastle Institute of Mining Engineers, my paper on "Canadian Coals," I was unable to procure a set of samples of these coals for analysis. I give the following from Dr. Dawson's "Acadian Geology" and other sources, which show the general character of the seams :—

JOGGINS.

Moisture	2·50
Volatile Combustible Matter	36·30
Fixed Carbon	56·00
Ash	5·20

MACCAN.

Volatile Matter	37·00
Fixed Carbon	59·18
Ash	3.82

STYLES.

	Fast coking.	*Slow coking.*
Moisture	4·05	4·05
Volatile Combustible Matter	33·72	38·18
Fixed Carbon	55·83	51·37
Ash	6·40	6·40

The Dominion Government have made arrangements for surveying a line of railway from Maccan to Barnes' Creek, on the river Herbert, and thence to the Joggins, a total distance of about nine miles. This line of road would prove a valuable feeder to the Intercolonial Railway, and an important outlet to the whole Cumberland coal district. It passes across and skirts the productive belt nearly the whole way. By it, in winter, the Joggins, Minudie and other mines would find an outlet to New Brunswick and the Upper Provinces. In summer, the Maccan, and Springhill, and other mines, would find by this road an outlet to a shipping port much nearer than Dorchester and Parrsboro', and open for a longer portion of the year.

The Joggins coal, I presume almost unknown in Halifax, is when carefully prepared a good steam coal. During this year the company have contracted to supply coal for a line of steamers calling at St. John. I am not in possession of any data as to its qualifications for gas and coke making.

The coal from the Scotia and Chignecto seams has found a ready market as a good lasting house coal, and its adaptability for that important use, iron making and working, is shown by the selection of the Chignecto property by the Steel Company of Canada as a fuel supply. The coal from the Styles seam is also well adapted for domestic use, while from trials made on the Intercolonial Railway, it would appear to be a good steam coal. From its action while burning it should also possess good

cooking qualities. This point however can be settled satisfactorily only by practical tests.

I do not know that there is more that I can add to this brief sketch of an important, but still almost unknown district, but will feel satisfied if I have been able to convey to you, and ultimately to the general public, any information which will serve to draw attention to the resources of our Province, and to place on record data which may possibly be utilized by future explorers

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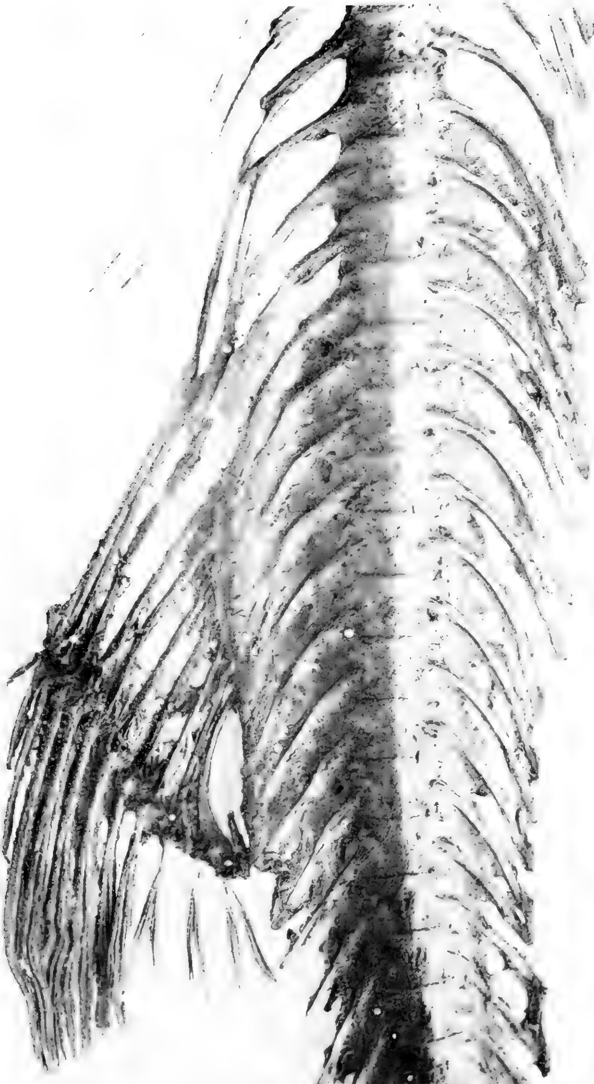
Morrow. Salmo salar 4

Proc. Nov. Scot. Inst. V. p 222

4

Morrow. Salmo salar. 5

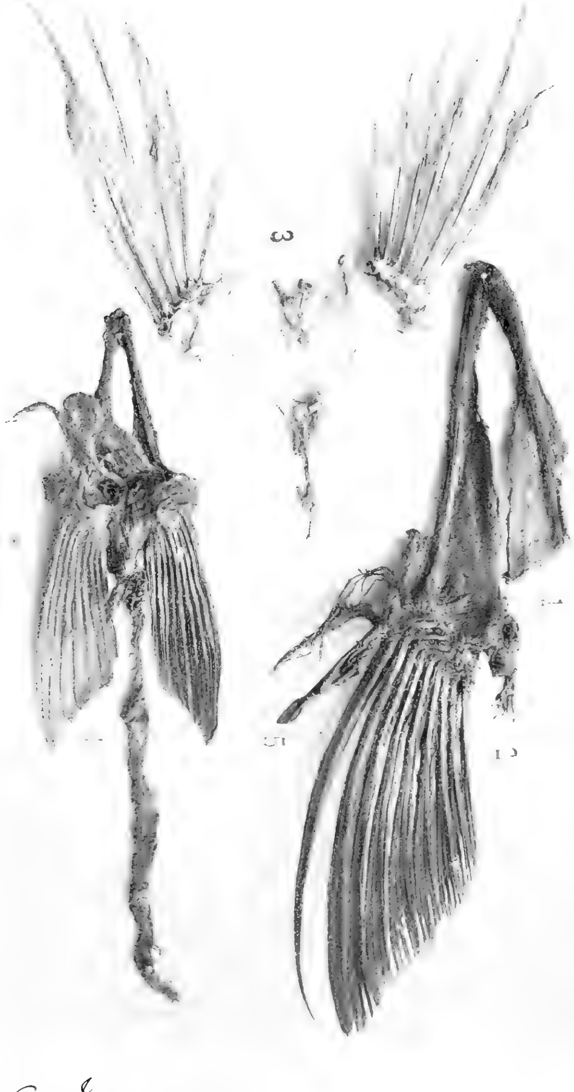


Proc. Nor. Scot. Inst. V. p. 222

Morrow. Salmo salar. 6

Proc. Nor Scot. Inst. V. p. 222

Morrow. Salmo Salar. 7



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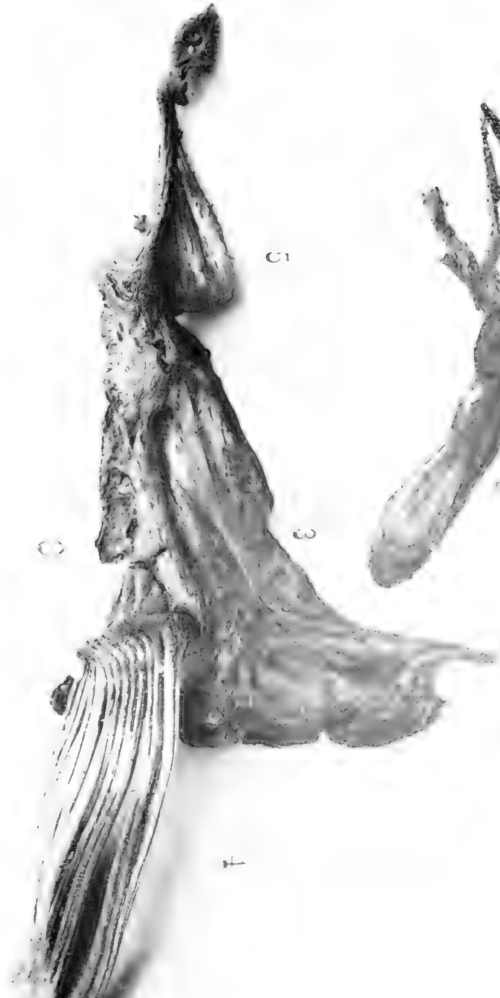
Morrow. Salmo salar. 8



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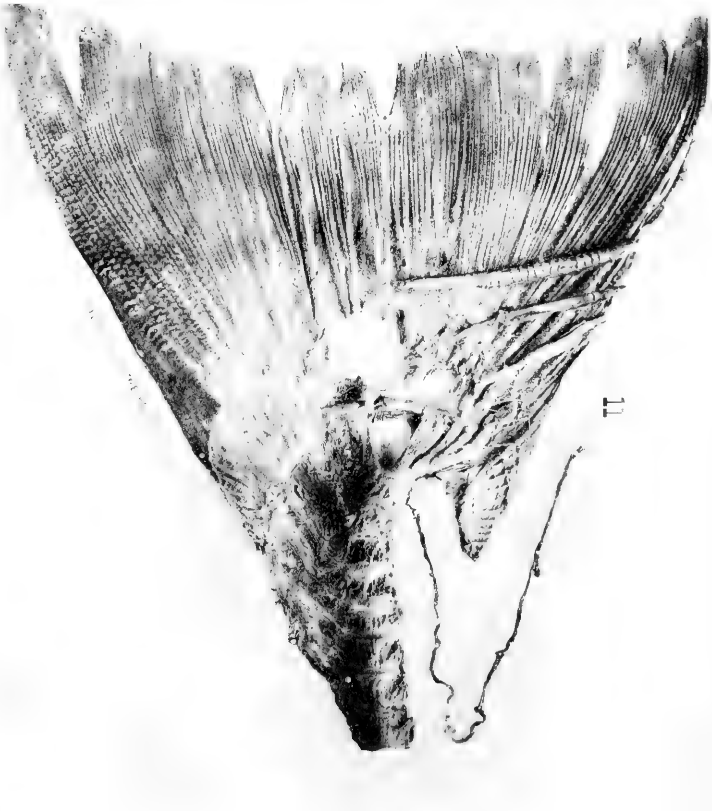
Morrow. Salmo salar. 10.

Proc. Nov. Scot. Inst. V. p.222

10

Morrow. Salmo salar. 11



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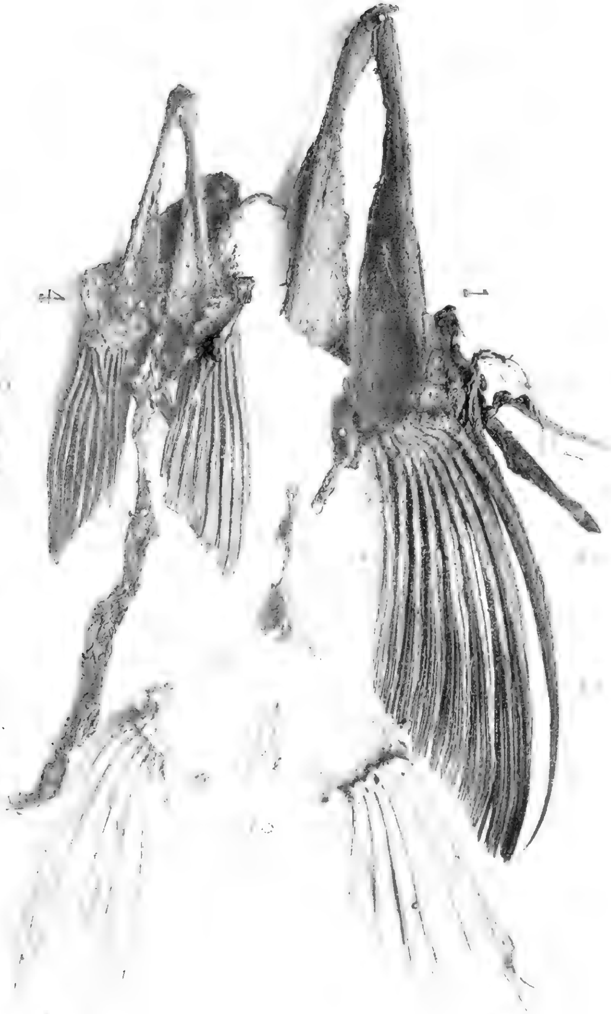
Morrow. Salmo salar. 12



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Proc. Nov. Scot. Inst. V. p. 376

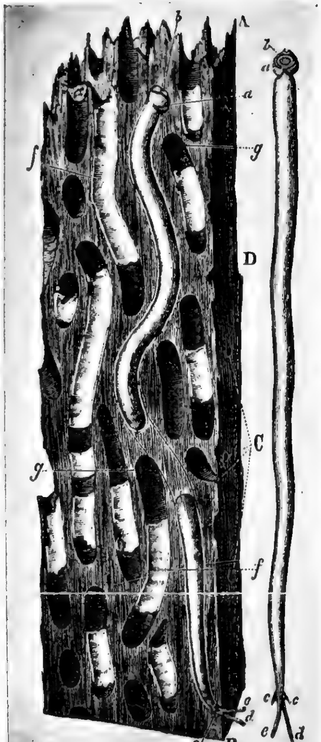

Fig. 12.—Wood exposed from November, 1874, to September, 1876, in crib at Pier No. 1, New York, North River, twenty-five feet below mean low tide.

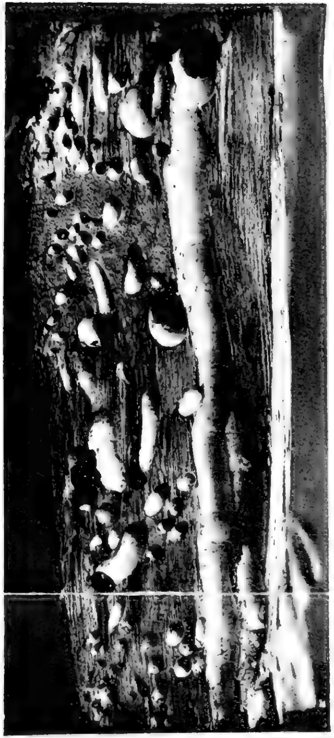

Fig. 14.—Spruce submerged two years in Coal Mining Company's wharf, Middle River, Pictou, N. S., four feet below low water.

Fig. 11.—This cut was made from a *Teredo navalis*, taken from a pile exposed two seasons (1876 and 1877) at Horn Island, Gulf of Mexico. When first taken from the wood it was eighteen inches long.

Gilpin. Nov. Scot. Shore birds 1

12

Proc. Nov. Scot. Inst. V. 6. 370

FIG. 15.—Hemlock from Yacht Club wharf, Halifax Harbor, N. S., attacked by Limnoria Lignorum. Enlarged 4 diameters.

FIG. 16.—Photograph of piece of spruce pile from Halifax Harbor, N. S., containing living Limnoria and Mussels.

Gilpin. Nov. Scot. Shore Birds. 2

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Nov 12 79

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